OCTOBER 10, 1960

missiles and rockets

THE MISSILE/SPACE WEEKLY

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Interview: Army R&D Chief Trudeau

ANSWER TO M/R OPEN LETTER

Kennedy Launches Defense Debate . . 12

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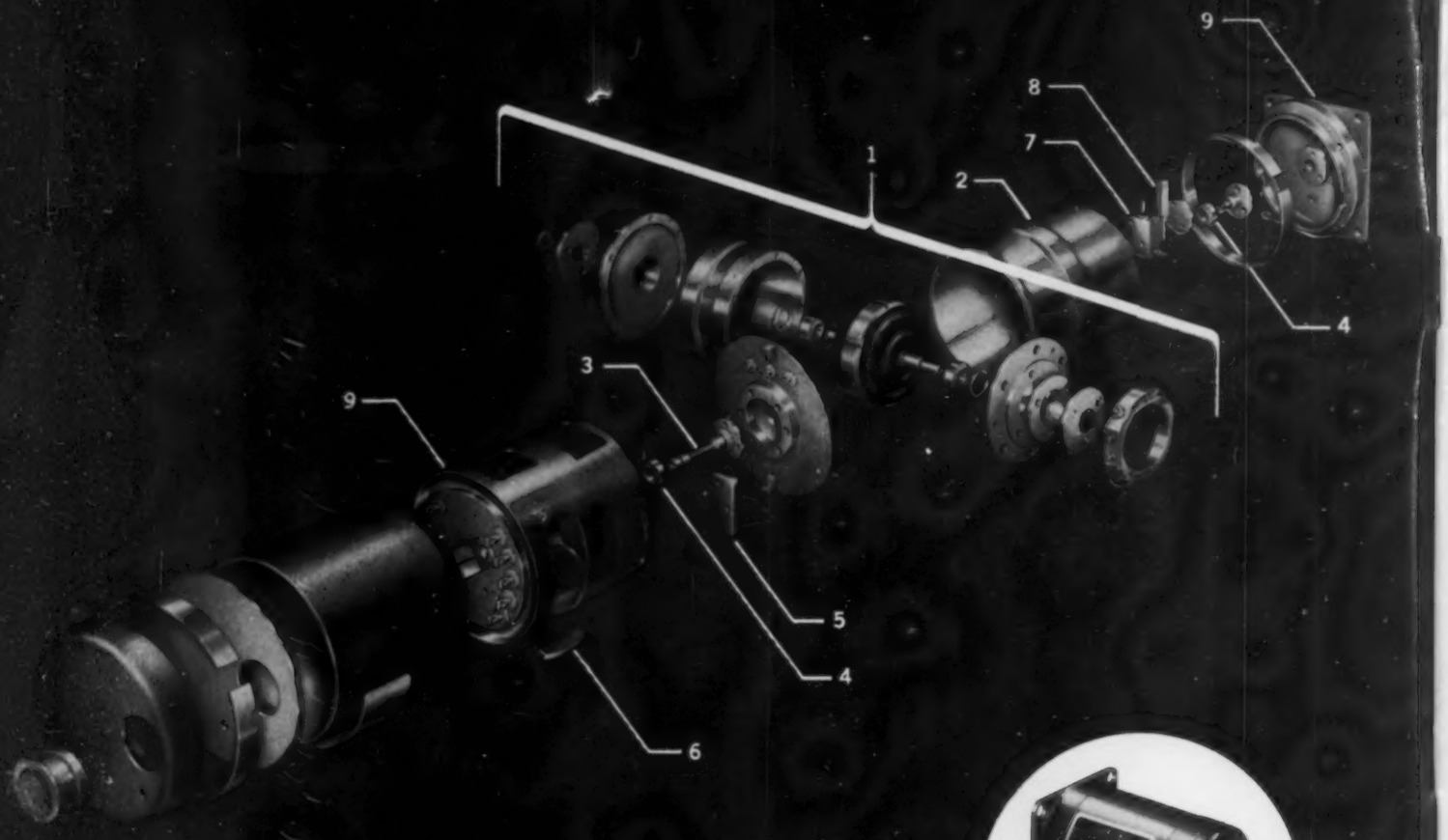

A LOOK UNDER THE COVER AT...

R 51 Series
Floated Rate Gyro

10 YEARS OF FLOATED RATE GYRO EXPERIENCE

OVER 40,000 AIRBORNE INSTALLATIONS—including the latest missile and aircraft programs—have consistently proved the extreme reliability of Daystrom miniature and subminiature rate gyros.

And for good reason. From more than 150 design variations, Daystrom's high-volume production capability assures that "standard" or "special" gyros can be quickly and inexpensively custom-assembled to your exact specifications. They offer either AC or DC motors, potentiometer or microsyn pickoffs and dashpot or viscous-shear damping. All models are either end or center flange-mounted, have a nominal temperature range of from −65°F to above +212°F and qualify to MIL-E-5272 or beyond. Special, continuous duty, high temperature units are available.

It's another example of Daystrom's ability to create better instruments and systems in smaller, more economical packages for military and commercial use. For complete information and specifications write for Data File MR-1151-2.

Typical of Daystrom floated rate gyros is the R 51 Series (DC Pickoff), an hermetically sealed rate gyro consisting of a **spin motor** (1) mounted on a **sealed gimbal** (2) that is restrained by a **torsion spring** (3). Alignment of the gimbal support is maintained by **bearings** (4) at both ends. A **potentiometer wiper** (5) is mechanically coupled to the gimbal. Precessional movement about the gimbal axis causes displacement of the wiper and this displacement is transmitted to a **potentiometer** (6). Damping is performed by two **damping assemblies** (7) with bi-metallic temperature-compensating **springs** (8). The rugged construction of the **castings** (9) assures maximum stability.

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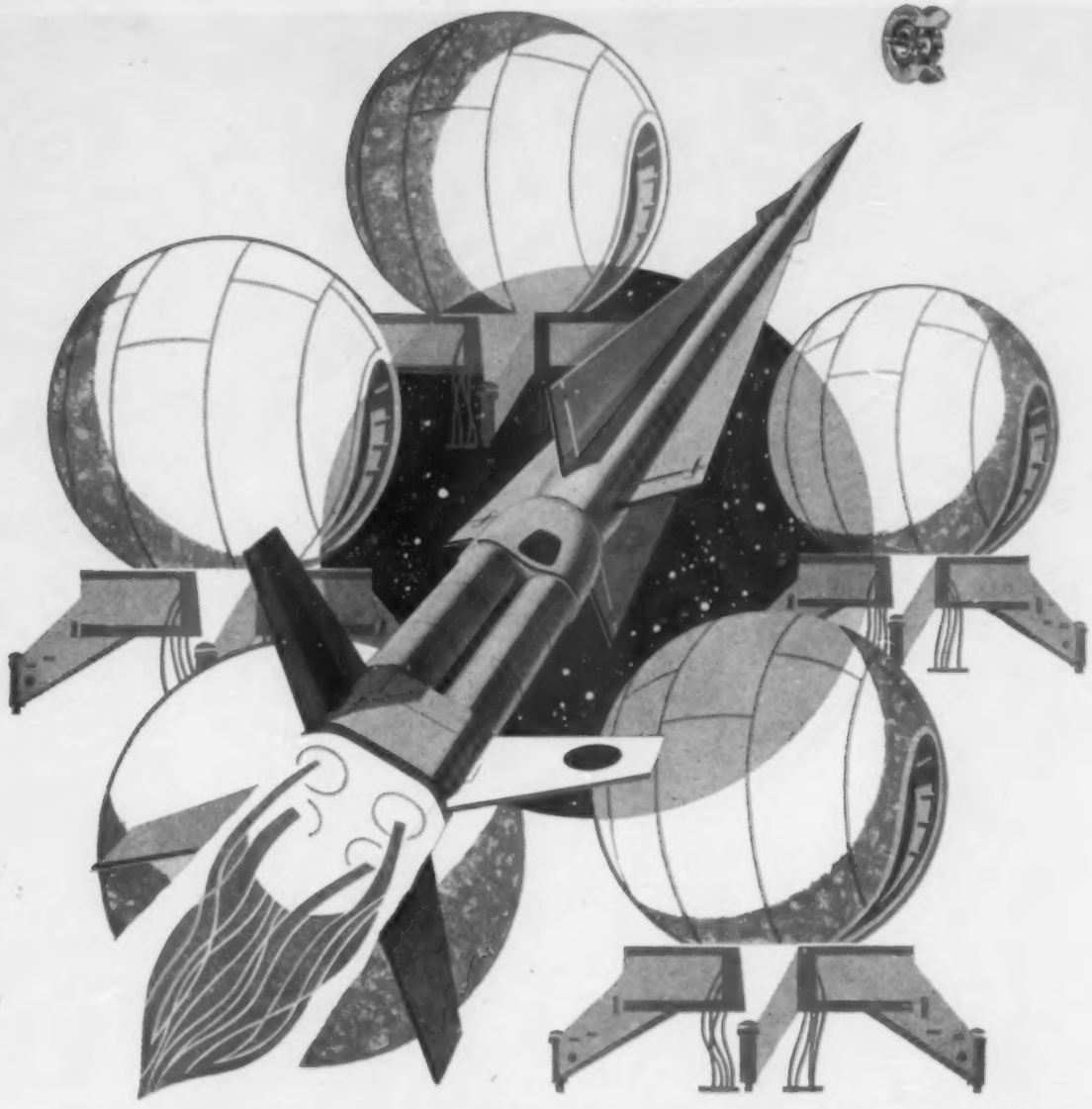

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N/D Designs Assembly Savings Into Critical Miniature/Instrument Ball Bearings!

Helping customers *simplify* instrument assembly is a specialty of the N/D engineering group. How? Through *creative* Miniature/Instrument ball bearing application and design. Often, a new ball bearing design will produce assembly savings in excess of its additional costs. Integral ball bearings, too, very often cut down difficult and costly hand assembly of shaft and parts.

A timely example of N/D customer assembly savings can be seen in Nike Ajax and Hercules missile ground support. Here, *special* N/D Instrument ball bearings are now used in precision potentiometers. New Departure engineers recommended eliminating two *single row* instrument bearings, mounted in duplex and requiring precision spacer and separate guide roller. They replaced this assembly with a *special* N/D *double row* high precision instrument ball bearing with integral outer race guide roller . . . and shaft mounted with a nut. This *one* recommendation produced cost savings of over 400%! In turn, the customer was able to reduce the potentiometer selling price to the government. What's more, the New Departure Instrument Ball Bearings improved potentiometer reliability!

You can look to minimum assembly costs and unsurpassed *reliability*. Include an N/D Miniature/Instrument Bearing Specialist in your early design level discussions. For immediate information or assistance, call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

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proved reliability you can build around

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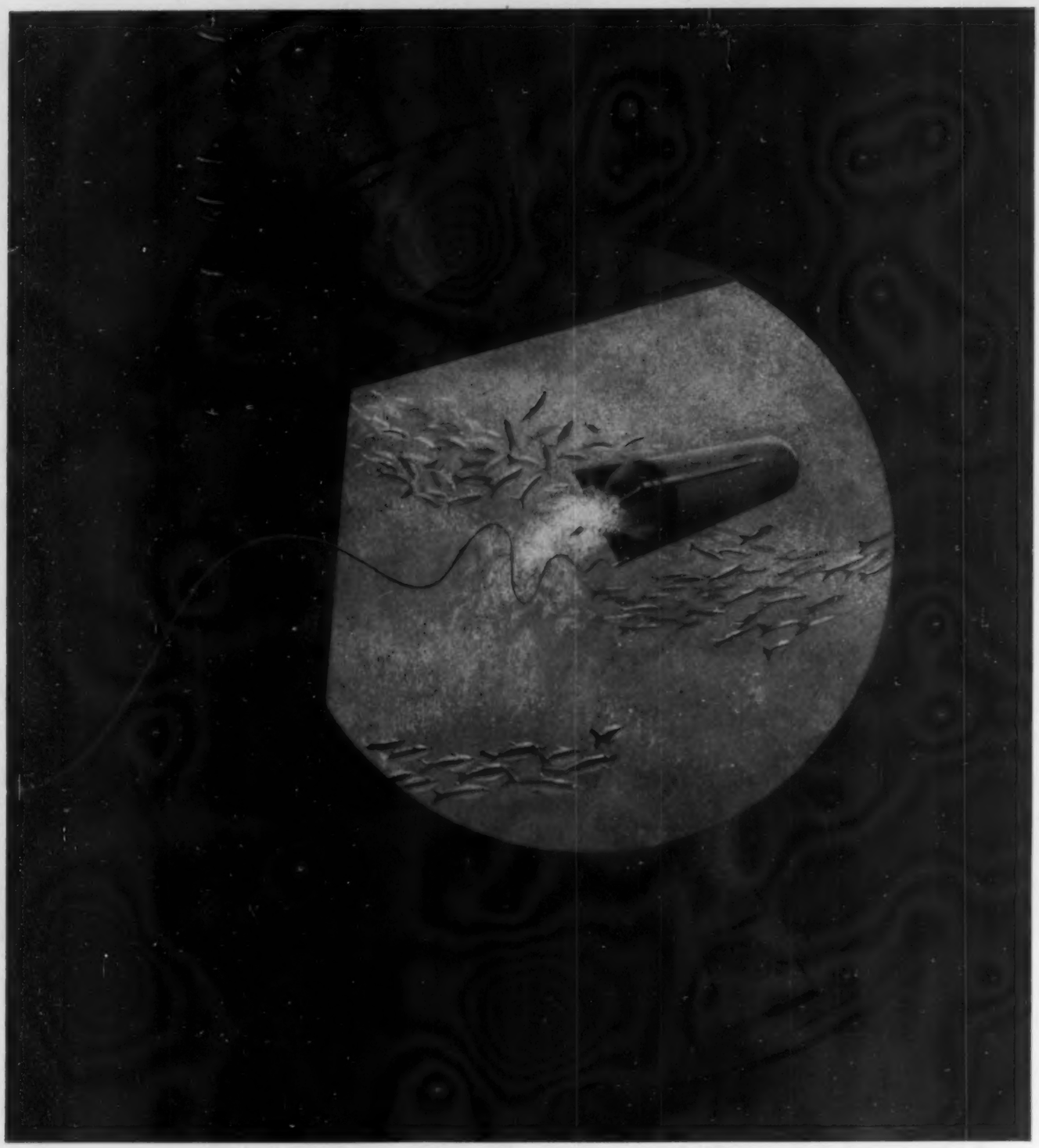

RIGHT NOW, VITRO IS HELPING THE NAVY change torpedoes into underwater guided missiles. ■ Today, wire guided torpedoes are key ASW weapons. Wire-guidance and bearing-rider fire control are essentials in modern underwater weaponry. Both were developed at the Silver Spring Laboratory. ■ Vitro engineers were responsible for the first wire guided torpedo system and its subsequent developments. These technical specialists are now engaged in programs to apply advanced, original concepts to underwater ordnance.

Vitro

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THE MISSILE / SPACE WEEKLY

missiles and rockets

October 10, 1960 Volume 7, No. 15

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THE COVER

Lt. Gen. Arthur G. Trudeau, Army R&D boss, says his service is the only logical developer of a land-based, 1000-mile-range tactical missile. See interview on p. 16.

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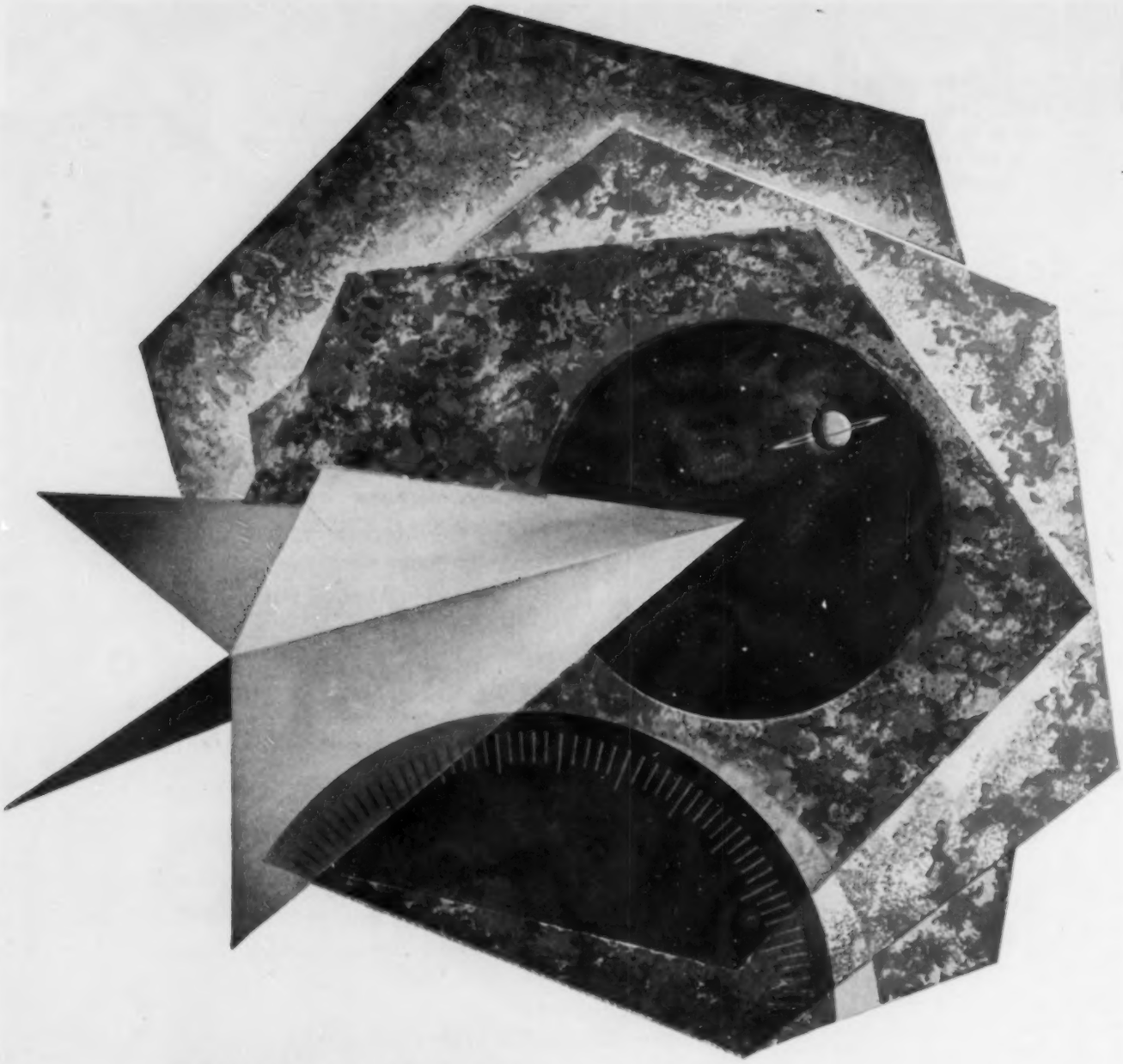

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The Countdown

WASHINGTON

Way to Speed Dyna-Soar?

COUNTDOWN understands there is some high-level sentiment in DOD to drop the weapon system requirement on *Dyna-Soar*—in order to speed its development. Some experts believe the present concept for the space vehicle should be a stepping-stone to a weapon, not an end product. If it were handled strictly as an R&D venture, then a lot of the "garbage" (redundancy, "idiot-proofing," etc.) could be eliminated initially. The hitch, however, is that the Air Force under Administration policy must now justify *Dyna-Soar* as a weapon, to get the necessary funding. If it drops this requirement, the wolves will move in.

Shell Game

Latest shift in Navy budget planning for FY '62 is understood to entail dropping a request for another aircraft carrier and applying the money to a school of nuclear-powered attack submarines. These subs are needed to protect *Polaris* subs.

Deployment Delay

Instead of getting the first *Polaris* sub—the George Washington—out on station late this month as hoped, the Navy now says it will be early in November. The delay amounts to about two weeks. And, COUNTDOWN is told it is attributable largely to the IAM strike earlier this year and last-minute equipment checkout.

Eagle vs. Typhon

A hot new rivalry in R&D may break out soon between the Navy's Bendix *Eagle* and its Westinghouse *Typhon*. The *Typhon* is a surface-to-air antimissile missile. *Eagle* is an air-to-air antiaircraft missile. But some advocates are reported to be claiming that *Eagle* also will have an antimissile capability.

NASA Visits SAC

A team of NASA scientists headed by Administrator T. Keith Glennan has given a briefing on their long-range plans to SAC. The group journeyed to Omaha at SAC Commander Thomas S. Power's request. Chief Topic: what the civilian agency believes it will be providing in technical capability and space hardware in the '60s.

On the Pad

First *Mercury-Redstone* may go this week from the Cape . . . *Tiros II* is scheduled tentatively for the week of Oct. 31 . . . Deadline for setting up another *Atlas-Able* has passed to make it possible for a pre-election moon shot.

Century Mark

Orbiting of the *Courier* communications satellite Oct. 4 (the third anniversary of *Sputnik*) was accomplished with the 100th launch of a Douglas *Thor*. Since its first shot Jan. 25, 1957, the *Thor* has been fired 63 times as an IRBM and 37 times in space experiments. The record: as an IRBM 10 shots were unsuccessful, 11 partially successful and 42 successful; as a space booster 4 shots were unsuccessful, 2 partially successful and the remaining 31 successful.

INDUSTRY

Five Were Quick

Only five out of 50 firms met the two-week deadline Aug. 26 for proposals on the *Minuteman* environmental control system. Winner is expected to get contract award within two weeks.

Front Office

In a top management shakeup, J. H. Carmichael has resigned as president of Fairchild Engine & Airplane Co. Founder Sherman M. Fairchild is stepping back in as acting chief executive officer. Carmichael's resignation came as the company reported losses of $587,000 for the first six months of the year.

At NASA

Bids are being asked by Oct. 30 at NASA's Marshall-Huntsville center on 42 aluminum LOX and RP tanks for *Saturn* Boosters 6 through 10 . . . There are only eight companies in competition for the Orbiting Geophysical Observatory satellite (Aerojet, Bendix, Convair, G-E, Grumman, Lockheed, RCA and STL) . . . At Huntsville a struggle is brewing between NASA and JPL facilities for jurisdiction over spacecraft guidance systems.

More Zeus Money

The Army is pumping more money into the *Nike-Zeus*. It has added $199 million to the development program in contracts awarded to Western Electric.

INTERNATIONAL

Australian CM Nose Cone

Australian scientist Dr. B. S. Thornton is offering the U.S. a new type of missile counter-measure nose cone. Special skin structure contains an electronic device to beam a false trajectory at enemy radar.

U.K. Midas Station

Ground surveys are under way in Britain for the siting of a ground station for U.S. *Midas IR* surveillance satellites. Preferred site is believed to be at Kirkbride, on the west coast of Scotland.

Rocket Tracker

EMI Electronics Ltd. has contracts with the British War Office and Swedish Army for a new radar tracker and trajectory calculator. The device is effective against mortar bombs and anti-tank rockets.

Overseas Pipeline

British Oxygen is ready to finance plant expansion with a $34 million stock issue . . . French Socialists are opposing De Gaulle's plan for creating a deterrent force . . . a German magazine quotes Dr. Wernher von Braun as saying he expects to be among the first passengers on a flight to the moon.

Engineering notes from the **SM/I REPORTER**

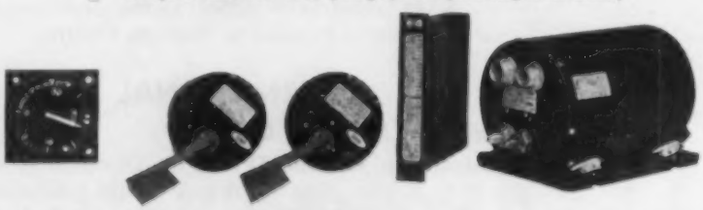
BY STANLEY M. INGERSOLL, *Capabilities Engineer*

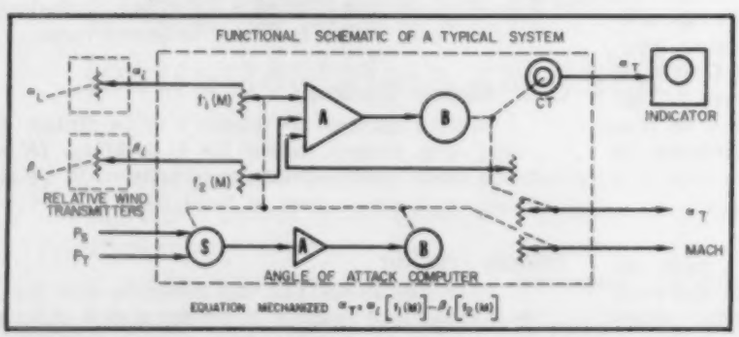
Report No. 11
ALC 603 Angle of Attack Computation and Display System

This system embodies engineering experience in angle of attack computational equipment that dates back to 1949. SM/I's Relative Wind Transducers became the first in the industry to satisfy military specifications. Elements of the system are pictured below; a vertical scale or clock-type indicator may be used for visual display. The design of the computer permits numerous variations with minimum modification. In all versions, this sub-system utilizes our Force Balance Mach Number Sensor, noted for its sensitivity and accuracy. As many as four data output servos each employing an SM/I transistorized amplifier can be provided in the unit without altering its exterior configuration. The gear train will operate various combinations of pots, synchros and other output devices. Normally, two SM/I relative wind transducers are used. One measures indicated angle of attack; the other measures angle of side-slip. After Mach number and side-slip corrections are made in the compensator assembly, the output function is the True Angle of Attack.

General Specifications

Operating range:
Angle of Attack ..... 50°
Angle of Yaw ..... 50°
Airspeed ..... 200 knots to 600 knots
Altitude ..... —1000 ft. to 60,000 ft.
Accuracy: ±¼°
Electrical Power Requirements: 115V, 400 cycle @ 2.5 amps (including vane heaters)
Computer Size: 8⅜"x5½"; weight, 7 lbs. (including shock mount)





For more information and complete operating specifications, write or wire SM/I today. Address your inquiry to Stanley M. Ingersoll, Capabilities Engineer.

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—when and where—

OCTOBER

National Electronics Conference and Exhibition, Hotel Sherman, Chicago, Oct. 10-12.

ARS Human Factors and Bioastronautics Conference, Biltmore Hotel, Dayton, Ohio, Oct. 10-12.

Society of Automotive Engineers, National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Oct. 10-14.

IRE/ASQC Reliability Training Conference, Southwest Area, Lake Texoma Lodge, Kingston, Okla., Oct. 10-15.

Government Contracting Course, National Defense Education Institute, sponsored by National Security Industrial Association and Harbridge House, Inc., Washington, D.C., Oct. 10-21.

Third AFOSR Astronautics Symposium, sponsored by Air Force Office of Scientific Research, Society of Automotive Engineers, Ambassador Hotel, Los Angeles, Oct. 12-14.

American Vacuum Society, Seventh National Symposium, Cleveland-Sheraton Hotel, Cleveland, Oct. 12-14.

Optical Society of America, Fall Meeting, Boston, Oct. 12-14.

American Society for Quality Control, 15th Midwest Conference, Broadview Hotel, Wichita, Kan., Oct 14-15.

Society for Photographic Scientists and Engineers, Revolution in High-Speed Processing, Washington, D.C. Oct. 14-15.

Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Oct. 17-18.

ASME-ASLE Lubrication Conference, Statler-Hilton Hotel, Boston, Oct. 17-19.

42nd National Metal Exposition and Congress, Trade and Convention Center, Philadelphia, Oct. 17-21.

American Ceramic Society, 13th Pacific Coast Regional Meeting, Ambassador Hotel, Los Angeles, Oct. 18-21.

Annual Meeting, Society for Experimental Stress Analysis, Hotel Claremont, Berkeley, Calif., Oct. 19-21.

Symposium on Space Navigation, Institute of Radio Engineers, Deshler-Hilton Hotel, Columbus, Ohio, Oct. 19-21.

Conference on Hypervelocity Projection Techniques, University of Denver, Institute of the Aeronautical Sciences, Denver, Oct. 20-21.

ASME-American Society of Mining, Metallurgical and Petroleum Engineers, Fuels Conference, Daniel Boone Hotel, Charleston, W.Va., Oct. 24-25.

Medical and Biological Aspects of the Energies of Space Symposium, sponsored by USAF Aerospace Medical Center, (ATC) Granada Hotel, San Antonio, Tex., Oct. 24-26.

Seventh Annual East Coast Conference on Aeronautical and Navigational Electronics, Lord Baltimore Hotel, Baltimore, Oct. 24-26.

Government Contracting Course, National Defense Education Institute, sponsored by NSIA and Harbridge House, Inc., Detroit, Oct. 24-Nov. 4.

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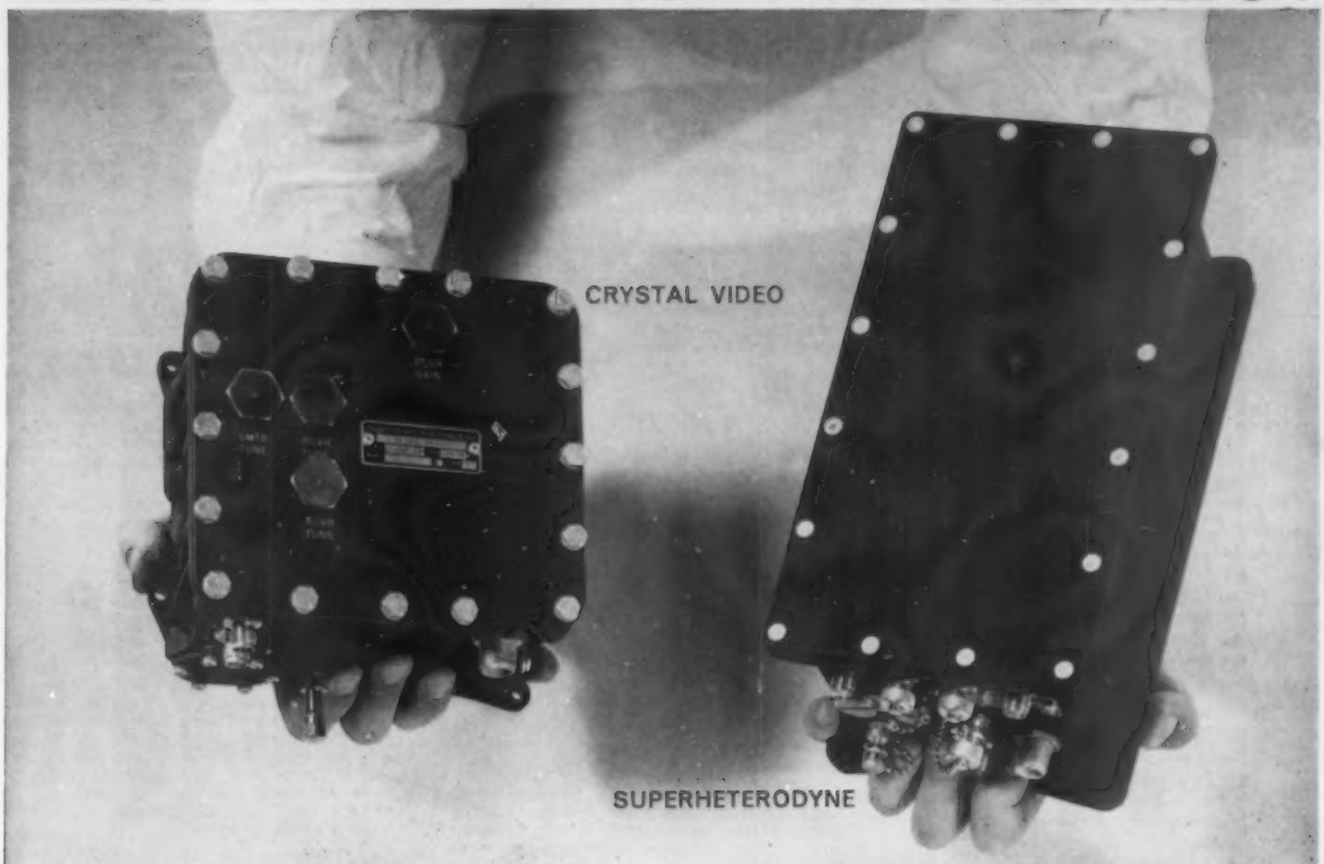
WHICH C-BAND BEACON FITS YOUR NEEDS ?



VOUGHT ELECTRONICS HAS BOTH!

For moderate range and sensitivity *(— 41 dbm)* . . . the economical, solid state crystal video beacon. *For long range and high sensitivity* (— 65 dbm) Vought Electronics offers a transistorized superheterodyne beacon.

Flight tested, off-the-shelf delivery. Both beacons have been flight tested and successfully operated at theoretical line-of-sight ranges to 60,000 feet. Lightweight, compact and rugged enough to operate under extreme field conditions, the aluminum alloy casting packages are pressurized, designed for hard mounting to the airframe. Accessible parts and readily available adjustments insure easy service. Both beacons are completely transistorized throughout, except for the magnetron and local oscillator.

Compatibility Vought Electronics beacons are designed to be compatible with existing C-Band radars (FPS-16, MPS-26, etc.) and with primary power and antennas available on modern aircraft.

FOR FULL PERFORMANCE AND DELIVERY DETAILS, write:

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Analog to Digital
CONVERTERS

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Angular Motions

IDL Shaft Angle Converters

are fully qualified
per MIL-E- 5272 A

for Operation:

At temperatures 0°F to 160°F
per Paragraph 4.1.1 Procedure 1
From 0.55 to 14.7 p.s.i.a.
per Paragraph 4.5.3 Procedure 3
Under vibration 5-5000 cps
per Paragraph 4.7.1 Procedure 1

for Exposure:

To Humidity and Temperature
per Paragraph 4.4.4 Procedure 1
To Sand and Dust
per Paragraph 4.11.1 Procedure 1
To 50 hour Salt Spray
per Paragraph 4.6 through 4.6.13
To Shock
per Paragraph 4.15.1 Procedure 1 and Paragraph 4.15.2.1
To 10 G's Sustained Acceleration
per Paragraph 4.16.2 Procedure 2

For Linear Motions, Model 500206 provides accuracies of 1 part in 1000 counts.

For Angular Motions, Model 500406 provides accuracies of one tenth degree; Model 500407 provides accuracies of a tenth of a minute.

Each unit provides bidirectional rotation for applications in mechanically geared systems. The Gray BCD coding system is easily translated into other digital format for visual readout or for recording.

For specifications on these components, ask IDL for their data sheet, "Shaft Position to Digital Converters" or price information, use your letterhead.

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contracts

NASA

$173,050—General Dynamics Corp., Cleveland, for liquid oxygen, liquid nitrogen and gaseous oxygen for the Lewis Research Center.

$116,680—Linde Co., Cleveland, for liquid oxygen, liquid nitrogen and gaseous oxygen for the Lewis Research Center.

$59,699—Universal Marine Construction Co., Sandusky, Ohio, for electrical equipment and wiring at Plum Brook Facilities, Sandusky, Ohio.

$38,000—High Voltage Engineering Corp., Burlington, Mass., for neutral beam source for Lewis Research Center.

NAVY

Cryogenerators, Inc., subsidiary of North American Philips Co., Inc., Ashton, R.I., for design, development, construction and testing of a low-pressure-cycle liquid-oxygen liquid-nitrogen generator. Amount not disclosed.

$8,000,000—Ryan Aeronautical Co., San Diego, for production of AN/APN-130 Doppler navigation sets.

$4,400,000—General Electric Co., Pittsfield, Mass., classified. (Three contracts).

$2,000,000—General Electric Co., Pittsfield, for production of fire control directors for the *Tartar* system.

$1,400,000—General Electric Co., Pittsfield, for manufacture of sea water batteries.

$495,000—Dorsett Electronics Laboratories, Inc., Norman, Okla., for manufacture of telemetering components for the *Terrier* and *Tartar* missiles. Subcontract from **Convair/Pomona.**

$402,900—Allison Div., General Motors Corp., Indianapolis, for design, development and initial production of an aerial target tow reel.

$250,000—Ramo Wooldridge, Los Angeles, for computer development.

$100,000—General Electric Co., Washington, for field service engineers for Mk 1 *Polaris* guidance system.

$75,000—Summers Gyroscope Co., Santa Monica, for guidance system components for the advanced version of the *Sidewinder*. Subcontract from **Motorola Inc.'s Military Electronics Div.**

$44,908—Cannon Electric Co., Los Angeles, for missile fire control system launching equipment.

AIR FORCE

Northrop Corp.'s Norair Div., Hawthorne, Calif., has received a "multimillion" dollar contract from **The Martin Co.-Denver**, for installation and checkout of *Titan* missiles and ground equipment at Ellsworth AFB.

Chance Vought's Astronautics Div., Dallas, for developing a restraint system to protect the space pilot against landing impact forces as high as 60 g's. System is being designed for advanced manned space vehicles. Amount not disclosed.

$8,938,436—Laboratory for Electronics, Inc., Boston, for components of the AN/ATN-131 radar set, spare parts and ground support equipment.

$6,000,000—Douglas Aircraft Co., Inc., Santa Monica, for components, spare parts, engineering and technical data for *MB-1 Genie*.

$1,800,000—Massachusetts Institute of Technology, Cambridge, for research and development.

$333,000—Sylvania Electric Products Inc., Applied Research Laboratory, Waltham, Mass., for research and experimentation involving electronic scanning storage techniques.

$250,000—Leach Corp., Compton, Calif., for ground support equipment for tactical *Titan* missile bases. Subcontract from **The Martin Co.**

ARMY

$199,125,000—Western Electric Co., New York City, for development of the *Nike-Zeus*.

$29,597,535—Raytheon Co., Waltham, Mass., for continued production of the *Hawk* missile system, divided as follows: $16,900,000 for production; $8,065,000 for manufacture of ground support equipment; $3,267,396 for engineering services; $1,374,139 for field maintenance and test equipment.

$20,000,000—Western Electric Co., New York City, for continued work on *Nike-Hercules*.

$16,217,452—Hercules Powder Co., Wilmington, Del., for ($14,735,425) continued production of rocket items including motors, propellants and explosives; ($1,482,027) varied items of propellants, explosives and maintenance. (Two contracts.)

$10,566,490—Raytheon Co., Waltham, Mass., for production of *Hawk* missiles, divided as follows: $4,673,699 for ground support equipment and maintenance test equipment for NATO; $4,019,265 for production of Hawk missiles for NATO; $1,873,526 for various equipment to be used in the program.

$5,640,375—Mason & Hanger, Silas Mason Co. Inc., New York City, ($2,472,224) for continued production of classified items; ($1,996,782) classified and ($1,171,369) medium caliber rockets, components and maintenance. (Three contracts.)

$3,399,739—Liberty Powder Defense Corp., E. Alton, Ill., for various propellants and explosives. (Two contracts.)

$1,555,791—U.S. Rubber Co., New York City, for various items, propellants, explosives and maintenance.

$1,374,317—W. L. Maxson Corp., New York City, for further work on components for the *Hawk* missile.

$1,286,749—Chrysler Corp., Detroit, for further work on the *Redstone* missile system.

$1,000,000—Convair, Fort Worth Division, for radiation shielding for the crew of a proposed combat vehicle.

$803,305—Perron Construction Co., Oak Park, Mich., for construction of radar tower and appurtenances at the Port Austin AF Station.

$376,000—Colorado Research Corp., Broomfield, Colo., for manufacture of special digital television systems.

$285,362—Biltmore Construction Co. of Clearwater, Fla., for construction of an engineering and operations building at Cape Canaveral Missile Test Annex, Patrick AFB.

$127,284—Douglas Aircraft Co., Inc., Santa Monica, for procurement of *Nike* repair parts.

$119,046—Sperry Rand Corp., Salt Lake City, Utah, for ground handling and test equipment and equipment training on the *Sergeant* missile. (Three contracts.)

$100,000—California Institute of Technology, Pasadena, for research on hypersonic wind tunnel.

$10,000—The Martin Co.-Orlando, for additional research and development work on the *Pershing*.

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ENGINEERS · SCIENTISTS

Dr. Sinclaire M. Scala (Ph.D., Princeton, Theoretical Aerodynamics) has been engaged in research in the fields of high temperature fluid flow since 1951. In 1956 he joined the Space Sciences Laboratory. Here, he pioneered the ablation concept as a solution to re-entry problems. In December 1959, he was appointed Manager, High Altitude Aerodynamics. Dr. Scala has published more than 20 papers related to missile and satellite re-entry problems. One of the most recent, "Shock Wave Structure in a Relaxing Diatomic Gas" (with L. Talbot) appeared in the Proceedings of the Second International Symposium on Rarefied Gas Dynamics, Berkeley, Calif., August 1960.

Investigamus Atmosphaeram Raram
NO. 2 OF A SERIES

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SAYS Dr. Sinclaire M. Scala, MANAGER, HIGH ALTITUDE AERODYNAMICS, AT GENERAL ELECTRIC'S SPACE SCIENCES LABORATORY

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Countdown for Survival

'If the Soviets Control Space . . . .

On these pages Sen. Kennedy blows the lid off the space/defense debate in the 1960 presidential race. Responding to M/R's open letter of last week, the Democratic nominee gets down to cases—calling for: 1.) national recognition of the strategic space race with Russia; 2.) reorganization of our defenses; 3.) immediate acceleration of ICBM programs. But he asks "elastic" dates on specific space projects. Vice President Nixon promises a reply soon.

by Senator John F. Kennedy

The space and defense proposals of MISSILES AND ROCKETS parallel, although in somewhat more detail, those of the Democratic Party platform. They are in line with my own thinking, our goals are identical.

My comments on the nine-point proposal of Sept. 27 follows. (M/R's points are in italics.)

1. Recognize as national policy that we are in a strategic space race with Russia.

We are in a strategic space race with the Russians, and we have been losing. The first man-made satellite to orbit the earth was named *Sputnik*. The first living creature in space was Laika. The first rocket to the moon carried a Red flag. The first photograph of the far side of the moon was made with a Soviet camera. If a man orbits earth this year his name will be Ivan. These are unpleasant facts that the Republican candidate would prefer us to forget.

Control of space will be decided in the next decade. If the Soviets control space they can control earth, as in past centuries the nation that controlled the seas dominated the continents. This does not mean that the United States desires more rights in space than any other nation. But we cannot run second in this vital race. To insure peace and freedom, we must be first.

2. Expedite present space projects to provide a new and bold program with the following goals; Manned space platform—1965; A U.S. citizen on the moon—1967-68; Nuclear power for space exploration—1968-69; A spacecraft which can take off from earth, travel to and in space, return and land under its own power—1968-69.

The target dates for a manned space platform, U.S. citizen on the moon, nuclear power for space exploration, and a true manned spaceship should be elastic. All these things and more we should accomplish as swiftly as possible. This is the new age of exploration; space is our great New Frontier.

3. Recognize that "space for peaceful purposes" is possible only if "freedom of space" is ensured; hence that the U.S. military must be given a predominant role in developing and carrying out the projects necessary to guarantee freedom of space.

Freedom of space must be assured, preferably by mandate of the United Nations. The United States must have pre-eminence in security as an umbrella under which we can explore and develop space for the benefit of all mankind.

4. Establish pre-eminent strategic, tactical and defensive forces with representation from all services.

Reorganization of the cumbersome, antique, and creaking machinery of the Department of Defense is high on the agenda of the new Democratic administration. I have asked Senator Stuart Symington to head an advisory committee which by December 31 will give me recommendations for this reorganization. Members of the committee include Thomas K. Finletter, former Secretary of the Air Force; Clark Clifford, who assisted in drafting the National Security Act of 1947; Roswell L. Gilpatric, who was a member of the Rockefeller Special Studies Project; Fowler Hamilton, former member of the Joint Intelligence Staff of the Joint Chiefs of Staff; and Marx Leva, a former Special Assistant to the Secretary of the Navy and Chairman of a Civilian-Military Review Panel for a Senate Committee. Dr. Edward C. Welsh, economist, military analyst, and a Legislative Assistant in the Senate for the past eight years, is Executive Director.

This committee will make practical recommendations as to what changes should be made in the organization and administration of our defense agencies to eliminate the present crippling effect of those problems upon our power.

The Democratic Platform calls for reorganization of the Department of Defense according to functions and missions. The committee will cer-

They Can Control Earth'—Kennedy

". . . billions can be saved by streamlining DOD and minimizing competition between services."

tainly study the feasibility and efficiency of: (a) A Strategic Command of such power and flexibility that it will deter surprise attack or major war—and indeed make it apparent to an enemy that surprise attack would be suicide; (b) A Tactical Command of strength and mobility capable of stamping out brush fire wars with speed and certainty; (c) A Continental Defense Command; (d) A Material Command, and (e) A Development Command.

Until 1945 major wars could be won by adhering to the principles of Napoleon, Nelson, Grant, Lee, Jackson and Sheridan. The atom has changed war, as it will change the world. We must have a modernized defense establishment to cope with the atomic age.

5. Recognize the necessity of greater defense funding to accomplish this, including a supplemental budget in January, 1961, to make it possible to: Speed up to a maximum degree the construction of ICBM launching bases, Polaris submarines and the Mach 3 missile-carrying B-70. Provide the Army with funds to begin the immediate procurement of already-developed modern missiles, other weapons and airlift.

Defense spending must be based on the security needs of the nation, not the pre-determined confines of a budget. While more money will be spent for modernity and mobility in our armed forces, I believe that billions can be saved by streamlining the Department of Defense and minimizing competition between services. Our competitors lie on the other side of the Iron Curtain.

In January, I will send to the Congress specific requests to:

–Accelerate our *Polaris, Minuteman,* and other strategic missile programs.

–Expand and modernize our conventional forces, giving them the versatility and mobility they require.

–Protect our retaliatory capacity from a knockout blow through hardening and dispersal of bases, the use of an air alert, and improvements in our air defense system.

–Streamline our defense establishment to give immediate reaction in this nuclear space age.

We must do more on antisubmarine warfare. Russian submarines equipped with missiles can threaten even our inland cities. We must speed up development of space warning systems and an antimissile weapons system.

6. Establish further-on defense spending by need and not by budget ceiling.

My position on this is expressed in No. 5. I add this. Basic research must be encouraged and expanded, on a long-range budget plan. Research cannot be started and stopped according to the whims of the budgeteer. A "break through" in a vital field may be achieved in five years—or ten —but no one can be sure until it happens.

7. Streamline defense regulations and procedures to make industry's role in the U.S. defense and space effort more effective.

Certainly defense regulations and procedures must be simplified, and the proliferation of secretaries, assistant secretaries, under-secretaries, special assistants and deputy assistants to secretaries, boards, commissions, councils, and committees must be rolled back. The Symington group is now hard at work on this tangled maze.

8. Take what steps may be necessary to establish and promote national scientific objectives.

Certainly national scientific goals will be our first objectives, continuously emphasized.

9. Re-establish decision-making in the U.S. defense and space organizations.

The Democratic Party has strength in depth among dedicated men familiar with defense problems. They will have a mandate to speed the decision-making process, and authority to make affirmative decisions very quickly. ⌗

(See editorial—Page 50.)

Countdown for Survival

M/R Readers Give Their Views

Emphasis on U.N.

To the Editor:

Congratulations on your open letter to the two presidential candidates challenging them to make space an important issue of the campaign. It's about time someone in a responsible position tried to awaken them to the crucial cosmic problems of the day.

However, I am disturbed at your general thesis, which seems to be parroting ex-General John B. Medaris' bitter memoirs, *Countdown for Decision,* which was just published. Basically, your logic seems to rest on a plea for giving the military the "predominant role in developing and carrying out the projects necessary to guarantee freedom of space" at the expense of NASA, which is relegated to a minor "promotion of scientific objectives," placed next to the bottom of your eight-step proposal.

With the current great debate taking place at the "rump summit" at the U.N. General Assembly meeting in New York stressing the dire need for immediate agreement on disarmament proposals—including control and inspection, it would seem to me that granting the U.S. military a larger role in space than it already has would only run counter to the trend of the debate in the U.N. and would tend to possibly inflame the neutral nations as well as Mr. K.

If our two presidential candidates would only consider the potential moral, strategic and tactical advantages of proposing (as you suggested in the last paragraph of your editorial) that, "If this defense of the freedom of space can be under the aegis of the United Nations, as it should be, that is fine," then we might have some hope of regaining the leadership initiative in the world that we have lost.

And who is to really say that the Russians will NOT provide any weapons or space vehicles necessary to do the policing for the U.N.? Let's not underestimate Mr. K! For all his vaudeville balcony antics, he is a shrewd politician who realizes the power of space propaganda. He has consistently played down the military aspects of the Soviet space experiments and stressed the scientific values, which he will undoubtedly do when he triumphantly announces the name of the world's first (Soviet) astronaut and his successful orbiting of the earth.

If Messrs. Kennedy and Nixon would only go on record in favor of carrying the President's four-step U.N. space control proposals one step farther—to make available American vehicles, tracking stations, ground equipment, launching pads and personnel for the establishment of a U.N. space program NOW, before it is too late, then we might be able to sleep better nights. And we wouldn't have to fear any Cosmic Curtains being dropped over our heads. Impossible? A dramatic plea before the U.N. General Assembly by either one or both of the candidates is still not out of the question—before election day!

Dr. Donald Cox
Rutherford, N.J.

MISSILES AND ROCKETS *is providing a forum here to focus attention on the space/defense issue in the presidential campaign—and after the election. This is an issue which the editors feel warrants much greater attention by the nation's leaders and the American public.*

Readers are invited to express their views on the vital questions of how this nation is to win the strategic space race with Russia. Correspondence should be addressed to:

Countdown for Survival
Missiles and Rockets
1001 Vermont Ave., N.W.
Washington 5, D.C.

Antimissile Defenses

To the Editor:

Although your proposal is comprehensive, I am somewhat surprised by the absence of a well defined position by MISSILES AND ROCKETS as it relates to an antimissile defense.

Our deterrent to Soviet nuclear attack upon the United States requires a proper balance between offensive and defensive means, and we must continue to improve both.

Defense against the intercontinental ballistic missile is a vital part of our whole concept of nuclear deterrent. This element of our deterrent will become increasingly important as the Soviet capability in ICBM's continues to grow, and will be even more essential if the Soviets should achieve an antimissile defense of their own at an early date.

The early achievement of an effective antimissile defense must be one of our highest priority requirements for our national survival.

William W. Quinn
Major General, GS
Chief of Information
Department of the Army
Washington

Argument for Flexibility

To the Editor:

I have read your open letter to Mr. Nixon and Mr. Kennedy with great interest.

There is reason for concern as to the adequacy of our current military and space programs. Technological progress is proceeding at a progressively increasing rate, weapons and vehicles of all sorts are becoming more complex and the cost of research and development, as well as production, is going ever upward.

As to military weapons and systems, many that we rely upon today are already approaching the threshold of obsolescence. The speed of new developments can be appreciated by the spectacular success of the *Polaris* program.

It is obvious that these things mean greater expenditures in the future if we are to maintain our military strength. It is encouraging to note that both Mr. Nixon and Mr. Kennedy have recognized this.

It must not be forgotten that in research and development new and unforeseen problems arise. It is generally impossible to plan a realistic budget for such programs. Research and development funding should be based on need and on built-in flexibility which will provide funding for new problems when they arise. We would never have got the atomic bomb on a budget.

It is difficult to distinguish between

(Continued on page 48)

Nixon's Reply Coming

The open letter from MISSILES AND ROCKETS to both Presidential candidates was delivered on the same day—Sept. 27.

When the reply from Senator Kennedy was received, Mr. Nixon's headquarters was apprised of this fact.

As M/R went to press, word from the Vice President was that a reply to the open letter was being prepared and would be ready for a subsequent issue—probably next week.

M/R Exclusive . . .

Red China May Have Missile Subs

by Frank G. McGuire

QUEMOY—Communist China is building up a missile-launching submarine fleet, according to reports from U.S. and Nationalist Chinese intelligence sources here.

The Red Chinese are said to have operational a Zulu-class submarine modified to launch two Soviet-designed missiles, designated as *T-10*. These missiles, carried vertically in the sail of the submarine, are armed with high-kiloton-yield nuclear warheads, according to U.S. officers, but cannot be launched from underwater.

According to information here, the submarines must return to port for any re-supply of missiles. Rapid modification of the Zulu-class vessel allowed time only for installation of basic capabilities in missile launching, without provisions for re-supply at sea.

Although sources were reluctant to discuss the *T-10* in detail, there were strong indications that its fuel is a liquid storable kept in the missile tanks to avoid necessity for handling fuels at sea.

• **"Getting bolder and better"**—Estimates of the total number of submarines in the Red Chinese navy range from 20 to 50, with an undisclosed portion of these modified for missile launching. Some submarines are believed to carry missiles other than the *T-10*, but again, numbers were not disclosed.

Admiral Harry D. Felt, Commander in Chief, Pacific (CINCPAC) said the Communist submarine force in the Pacific numbers about 120 to 160, with 100 to 110 being Russian naval units.

"Their submarines are getting bolder and better," he said, "and we're seeing more and more of them out here. They don't seem to be conducting as much reconnaissance with their Pacific submarine fleet as they are with their Atlantic fleet, however."

He pointed out that development work of a missile-launching submarine "has been proceeding well" in the Communist naval forces, but did not mention the *T-10* by name.

• **More in arsenal**—In addition to the *T-10*, other missile and rocket threats faced by the Nationalist Chinese include:

–*GVAI* tactical bombardment rockets emplaced on the mainland and other Communist-held islands near Quemoy. These weapons, barrage types, are fired in salvoes from multiple-tube launchers. They are being replaced in Soviet military units, and now are used by other Communist forces.

–Air-to-ground rockets used for strafing by Mig-17 jet aircraft. These unguided rockets of the *Mighty Mouse* class have been fired on Quemoy during raids by Communist Chinese jets.

–Large surface-to-surface missiles are being deployed opposite Quemoy in Fukien province, reportedly the most heavily militarized province on the Chinese mainland. Types are not definitely known, but probably consist of the *T-5*, *T-5B*, and other tactical missiles with ranges of less than 1000 miles.

• **Chiang would welcome big missiles**—At a Taiwan press conference, President Chiang Kai Shek said in response to an M/R question that he doubts the Red Chinese will have their own nuclear capability within three years.

"Any such weapons they acquire within the next three years will come from Russia," he said.

He indicated the Republic of China would welcome strategic missiles on Taiwan to counter the expected buildup on the mainland. ■

The Missile/Space Week

GE Claims Defense Work Moving Well

The first week of a nationwide strike against General Electric left its defense business largely unhampered, company officials said. The midweek picture: Flight Propulsion Div., Cincinnati, participating unions voted not to strike; MSVD, Philadelphia, no picketing; Burlington, 90% production; Electronics Park, Syracuse, some picketing but plants continued to operate; Lynn, Mass. (aircraft engine), heavy picketing but work continuing.

The International Union of Electrical Workers demanded a two-year contract with wage increases of 3½% each year. It also called for supplementary unemployment benefits, improved vacation and holiday schedules, a union shop, and continuation of a cost-of-living escalator clause. GE's three-year counterproposal offered a 3% immediate raise and another of 4% on April 2, 1962. It also offered a retraining plan for workers who lose their jobs because of lay-offs or plant closings and proposed improved pension and insurance plans.

BOB Releases More Money

The Administration is continuing to dip into the $621 million added by Congress to the '61 defense budget. In its annual mid-year review, the Bureau of the Budget estimated it will increase Fiscal 1961 spending for military procurement by some $350 million.

Last week, DOD released $169 million added by Congress. This leaves $449 million to be obligated. A $150-million R&D boost for *Samos* and the 2400-mile *Polaris* plus an $87-million increase in obligational authority for missiles were included.

The extra money for missiles will go to *Minuteman* and a step-up in *Polaris*. A major increase of $345 million for two additional *Polaris* systems is listed as available for obligation and an added $540 million for aircraft procurement may go partly to the B-70.

Trudeau says Army Must be Given the

R&D chief, in exclusive interview, also calls for more air transport for missiles, closing the lead-time gap, step-up in basic research, and preparation for chemical war

by James Baar

LT. GEN. Arthur G. Trudeau, chief of Army R&D, bluntly contends that today there is "no sense" in anyone but the Army developing a land-based, 1000-mile-range tactical missile.

At the same time, the tough, intellectual general said in an interview that gave a preview of Army R&D trends:

–The next generation of Army missiles must be even more "air-transportable" than the latest one. The goal is the rapid movement of missiles in light Army STOL and VTOL planes.

–The three-to-four-year lead-time gap between U.S. and Soviet R&D weapon programs must and can be closed anytime there is sufficient support to do it.

–The military services must do more work in basic research, but even greater work of this kind must be taken on by industry.

–The United States must be prepared to meet the Soviet threat of waging chemical and biological war. Many military men contend it could be the cheapest weapon system available.

The 58-year-old general talked as he relaxed with a cigar in his Pentagon office. It was late in the afternoon and fall sunlight cast the shadows of models of Army missiles across the carpet.

He made the Army's case for developing a 1000-mile-range missile in cold, sledgehammer sentences.

"A field commander must be able to reach out at anything the enemy is throwing against him," he said. "He should have the ability to use his weapons without having to go through a dozen channels. Otherwise the target is gone—or he's clobbered.

"The Russians, of course, have missiles all the way up from short-range to ICBM's. And all are under the control of the Red Army."

Trudeau did not discuss specific competing programs. However, his remarks clearly supported Army proposals to develop a 1000-mile-range *Pershing II* and brushed aside Air Force proposals to develop a 1000-mile tactical-range missile known as the *TBX*.

• **The last 15 minutes**—Turning to strategic considerations, Trudeau noted bitingly that some military men saw little need for an Army at all.

"If you subscribe to the theory that any war means a nuclear exchange and that will be all, and if we're to lie down and cry in our beer because our cities have been bombed, then they are right," he said.

"But I say no matter what happens we can do something about it. We must have the will and ability to fight to a conclusion. And as Marshal Foch once said the battle is won by the Army fighting the last 15 minutes."

• **Doubts on obsolescence**—Moreover, Trudeau, said, any future war will not necessarily involve nuclear weapons or missiles of any size.

"The day of conventional artillery is not over for close-in combat of 20,000 to 25,000 yards," he said. "It can fire accurately under any weather conditions, it can fire continuously and an artillery round costs only a fraction of what a missile costs.

"I can conceive of nothing today in missiles that doesn't cost more than $1000 a round as compared to less than $100 for artillery. Therefore, an artillery shell with a nuclear warhead has a very great appeal. If nuclear weapons are ruled out, it can be absolutely the best bet."

Trudeau grinned.

"This is an interesting thing about the Congo," he said. "It shows that all weapons become obsolescent but none becomes obsolete.

"The bush knife and the spear are pretty effective in Africa. Life is cheap. And a man doesn't make much noise

ARMY'S PERSHING tactical missile on its transporter-erector-launcher. The Army wants to develop the Martin missile into a 1000-mile-range version. The Air Force wants to build a 1000-mile-range bird of its own.

1000-mile-range Missile

using them."

• **Plea for basic research**—The general then turned his thoughts to R&D problems. He said the nation has a tremendous need for more basic research, but the need is not appreciated.

"Instead, there is a tendency to cut down on basic research," he said. "People think that with all this technology everything is going to be hunky-dory. I don't think it is.

"We are just beginning to learn something about materials and electronics, for instance. But, even with this new knowledge that we have, little commercial use is made of it. Industry's idea is to keep equal or just ahead of the competition—no more effort is needed."

Trudeau took a puff of his cigar and shook his head.

"We are fighting for survival against Russian technology," he said. "Industry has got to be more interested in basic research. A fair number of companies are. But more should be—rather than wait for the government to fund it.

"The smart company puts a reasonably fair share of its profits back into basic research."

• **Money bind**—Lastly, Trudeau took up the Army's small share of the defense budget.

"Funding directly affects this business of lead-time in developing a weapon," he said.

"We showed what we could do in the *Davy Crockett* program. We had everyone behind it. There were no roadblocks. It was always adequately funded. A task force was set up under a lieutenant colonel who reported any problems directly to me. The job was finished in less than three years."

Trudeau said this could be repeated anytime that the necessary conditions can be fulfilled. But he noted that in recent years funds have been so tight that the Army has been unable to buy large quantities of the new weapons already developed.

"We're so poor that there is great pressure to spend our dollars on weapons already proven rather than on developing new ones," he said.

It was not said in a tone of complaint. He was merely stating a fact—a commodity with which his career shows he has dealt with the utmost respect.

• **Man of many parts**—Trudeau is something of a Renaissance man.

He was graduated from West Point in 1924 as an engineer and until World War II served in the Corps of Engineers, taking part in a number of large public works projects. In World War II he became one of the nation's leading experts in amphibious warfare. After the war, he became a schoolmaster and a student of economics when he served as deputy commander of the Army War College.

Earlier in his life, he missed seeing battle because two major combats in which he would have been involved failed to materialize; he was in command of a base preparing for the assault on Japan in 1945 and in command of the troops in Germany who were scheduled to break through to blockaded Berlin in 1948. But during the Korean War he assumed command of the 1st Cavalry Division in Japan and the 7th Infantry Division in Korea.

Later he became chief of Army Intelligence and traveled the world as a military diplomat. Finally, he became chief of R&D in 1958.

This short, heavy-set general and engineer and scholar has always been a good athlete as well. He played polo until he was past 40. He still plays golf in the low 80's.

He is a musician. He has played guitar with his left hand most of his life. He writes light verse.

He is very religious. When in Washington, he attends mass daily at the Roman Catholic Chapel at Ft. Meyer, Va., where he and his wife live.

He is an orator whom the Army has used repeatedly to impart its ideas to the public. Since becoming chief of Army R&D, he has made several-score major speeches a year.

• **"No status quo"**—It is in these speeches that he has expressed much of his hard-driving personality, much of a great belief in character and will.

In one speech earlier this year he said: "The tides of history cannot be contained and there is no status quo. Unless we have the urge to push onward and upward, we shall be thrust back."

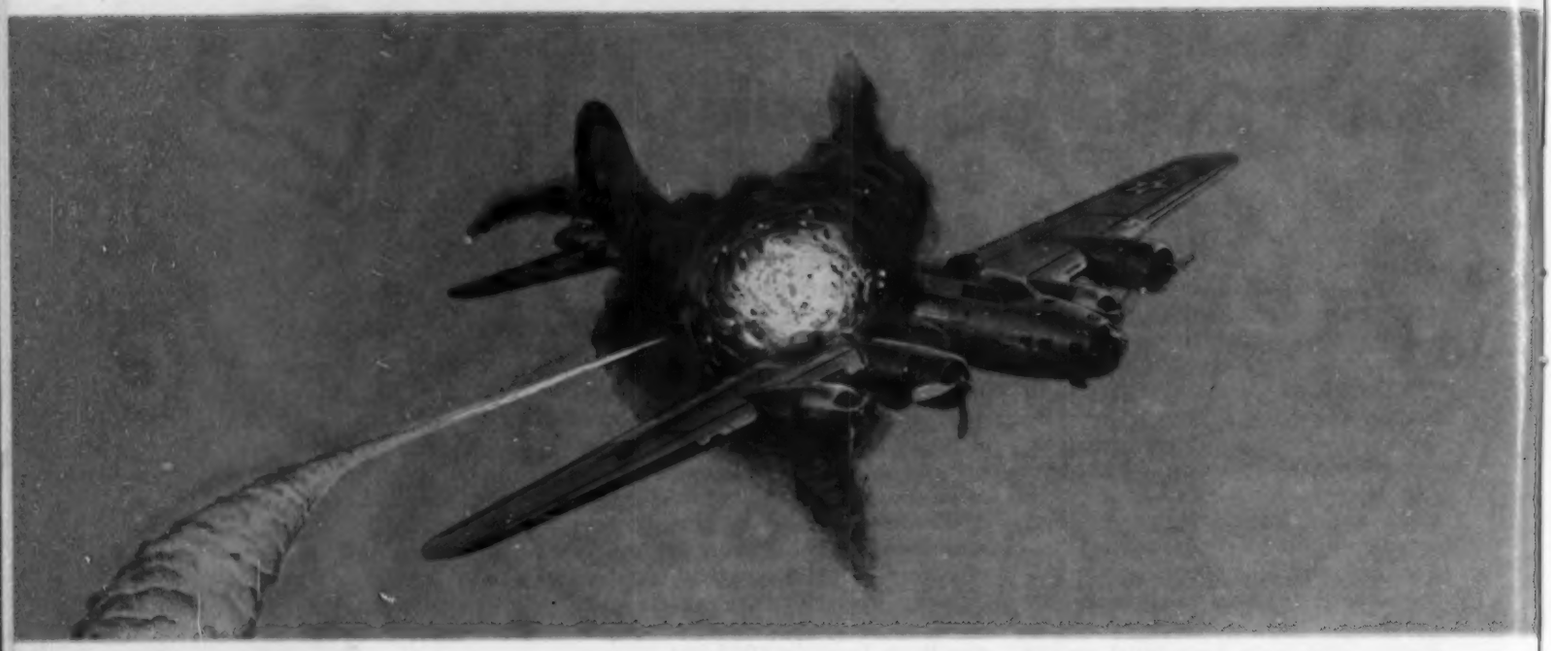
But possibly he made his thoughts even plainer in a recent article that he wrote for *Orbis*, the journal of the University of Pennsylvania's Foreign Policy Research Institute.

"We are all teammates in this relay race against the stopwatch of history and the price of defeat is oblivion and slavery . . .," he wrote.

"THE RUSSIANS, of course, have missiles all the way up from short-range to ICBM's. And all are under the control of the Red Army."

"I can think of no better way to assert what I believe our national spirit should be today than to echo the words of another Vermonter of earlier days. When Ticonderoga fell to the Green Mountain Boys, the Continental Congress in its timidity considered giving the captured cannon back to the British, whereupon Ethan Allen wrote Congress a letter saying:

" 'I wish to God America would at this critical juncture exert herself . . . She might rise on eagle wings and mount up to glory, freedom and immortal honor if she did but know her strength.' "



An M/R Directory

MOBILE MISSILE PLATFORMS

Aircraft on both sides of the Iron Curtain are bristling with a wide variety of missiles—next step: missiles to be launched by spaceships

AIRCRAFT TODAY is providing the air forces of the world with the most mobile of all available missile platforms

U.S. Air Force tactical aircraft are armed with Martin air-to-surface *Bullpups*, and air-to-air Hughes *Falcons*, GE-Philco *Sidewinders* and Douglas *Genies*.

SAC bombers already carry the 500-mile-range North American *Hound Dog*. And by the mid-'60's the B-52 and B-70 are scheduled to carry the 1000-mile-range Douglas *Sky Bolt*.

Overseas, British aircraft are armed with air-to-air de Havilland *Firestreaks* and *Red Tops* and air-to-surface Avro *Blue Steels*. French aircraft are armed with air-to-air *AA-20's* and Matra *R-511's*.

Swedish aircraft are carrying air-to-surface Robot *304's*. Italian planes bristle with SISPR *C-7's*.

Many NATO nations use *Sidewinders* on their interceptors. The British plan to deploy *Sky Bolts* aboard their V-bombers.

On the other side of the Iron Curtain, Soviet bombers carry *Komet D* air-to-surface missiles. Soviet interceptors are armed with the air-to-air *M-100D*.

The Russians are reported to be developing a nuclear-powered aircraft. Such a plane would be certain to carry air-to-surface missiles.

The next step for both East and West: Development of missiles to be launched from spacecraft.

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THE MISSILE/SPACE WEEKLY

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United States

F-89 SCORPION

Type: Interceptor.
Prime contractor: Northrop Corp.
Armament: Two Genies; two 52-rocket pods of folding fin air-to-air rockets.
Performance: SPEED—more than 600 mph. CEILING—more than 45,000 ft. RANGE—more than 1000 miles.
Powerplant: CONTRACTOR—Allison. TYPE—J35-A-35 turbojet with after burner. NUMBER—two.
Deployment: Air Defense Command, Air National Guard.
Remarks: Being phased out in favor of more advanced interceptors of 100 series.

F-89 SCORPION

F-100 SUPERSABRE

Type: Tactical fighter.
Prime contractor: North American Aviation, Inc.
Armament: Four GAR 8 Sidewinders; four M-39 20 mm. cannon; HE or nuclear bombs.
Performance: SPEED—more than 800 mph. CEILING—more than 50,000 ft. RANGE—more than 1000 miles.
Powerplant: CONTRACTOR—Pratt & Whitney. TYPE—J-57 P-21 with afterburner.
Deployment: Tactical Air Command, USAF in Europe and Pacific, Air National Guard.

F-100 SUPERSABRE

F-101B VOODOO

Type: Tactical fighter.
Prime contractor: McDonnell Aircraft Corp.
Armament: Combinations of 2 Genies or 2 GAR 2A Falcons, and four M-39 20 mm. cannon; HE or nuclear bombs.
Performance: SPEED—more than 1200 mph. CEILING—more than 50,000 ft. RANGE—more than 1000 miles.
Powerplant: CONTRACTOR—Pratt & Whitney. TYPE—J-57. NUMBER—two.
Deployment: Tactical Air Command, Air Defense Command, USAF in Europe and Pacific.

F-101B VOODOO

F-102 DELTA DAGGER

Type: Interceptor.
Prime contractor: Convair Division of General Dynamics Corp.
Armament: Six GAR 1B or 6 GAR 2A, Falcons plus 24 Z-75 folding fin air-to-air rockets.
Performance: SPEED—supersonic. CEILING—more than 50,000 ft. RANGE—more than 1000 miles.
Powerplant: CONTRACTOR—Pratt & Whitney. TYPE—J-57-P-23 turbojet with afterburner.
Deployment: Air Defense Command.

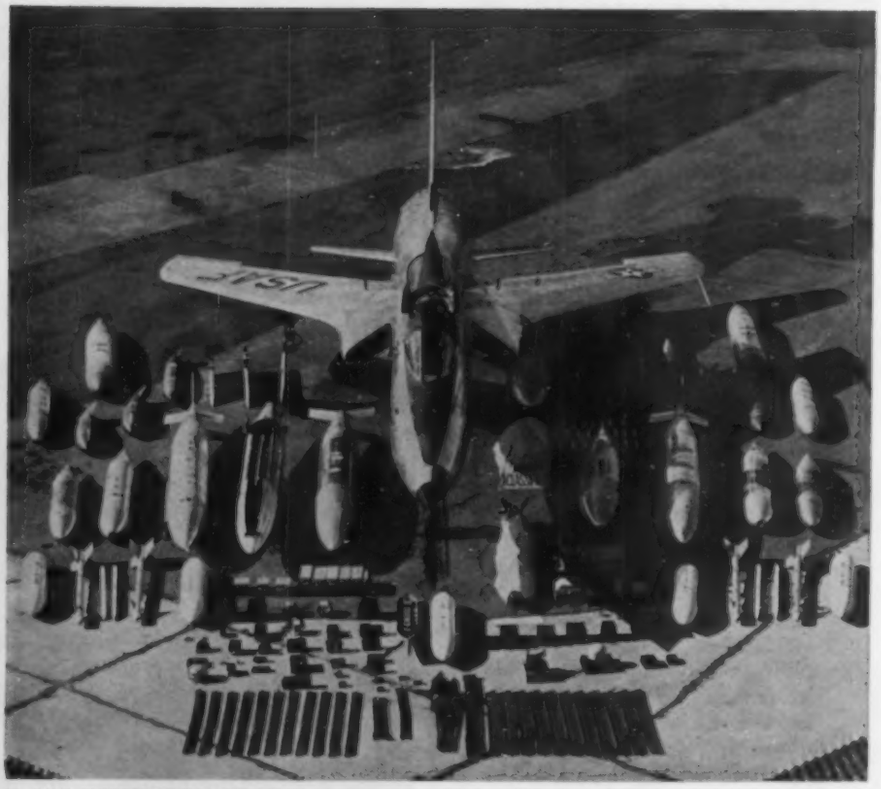
F-102 DELTA DAGGER

F-104 STARFIGHTER

Type: Interceptor, tactical fighter.
Prime contractor: Lockheed Aircraft Corp.
Armament: 2 GAR-8 Sidewinders; HE or nuclear bombs.
Performance: SPEED—more than 1400 mph. CEILING—more than 90,000 ft. RANGE—more than 1000 miles.
Powerplant: CONTRACTOR—General Electric. TYPE—J-79 with afterburner.
Deployment: Air Defense Command, Tactical Air Command.

F-105 THUNDERCHIEF

Type: Tactical fighter.
Prime contractor: Republic Aviation Corp.
Armament: Combinations of Sidewinders, Falcons, rockets; 4000 lbs. of HE or nuclear bombs.
Performance: SPEED—more than 1200 mph. CEILING—more than 55,000 ft. RANGE—more than 1500 miles.
Powerplant: CONTRACTOR—Pratt & Whitney. TYPE—J-75 with afterburner.
Deployment: Tactical Air Command.



F-105 THUNDERCHIEF

F-106 DELTA DART

Type: Interceptor.
Prime contractor: Convair Division of General Dynamics Corp.
Armament: 1 Genie and 4 GAR 3A or 4A Falcons.
Performance: SPEED—more than 1400 mph. CEILING—more than 50,000 ft. RANGE—about 1500 miles.
Powerplant: CONTRACTOR—Pratt & Whitney. TYPE—J-79-9 turbojet with afterburner.
Deployment: Air Defense Command.

F-106 DELTA DART

B-47 STRATOJET

B-47 STRATOJET

Type: Strategic medium bomber.
Prime contractor: Boeing Airplane Co.
Armament: Quail, two 20 mm. cannon in tail turret, more than 20,000 lbs. of HE or nuclear bombs.
Performance: SPEED—more than 600 mph. CEILING—more than 40,000 ft. RANGE—more than 3000 miles.
Powerplant: CONTRACTOR—General Electric. TYPE—J-47. NUMBER—six.
Deployment: Strategic Air Command bases overseas.
Remarks: B-47's are being phased out for B-58's.

B-52 STRATOFORTRESS

B-52 STRATOFORTRESS

Type: Strategic heavy bomber.
Prime contractor: Boeing Airplane Co.
Armament: Two Hounddogs, Quail; more than 20,000 lbs. of HE or nuclear bombs. H models will carry Sky Bolts.
Performance: SPEED—more than 600 mph. CEILING—more than 50,000 ft. RANGE—(A to F series) more than 6000 miles; (G) more than 7500 miles; (H) more than 9000 miles.
Powerplant: CONTRACTOR—Pratt & Whitney. TYPE—J-57 turbojet. NUMBER—eight.
Deployment: Strategic Air Command bases in the United States and Puerto Rico.
Remarks: B-52's also are used as a launching platform for X-15 rocket planes.

B-58 HUSTLER

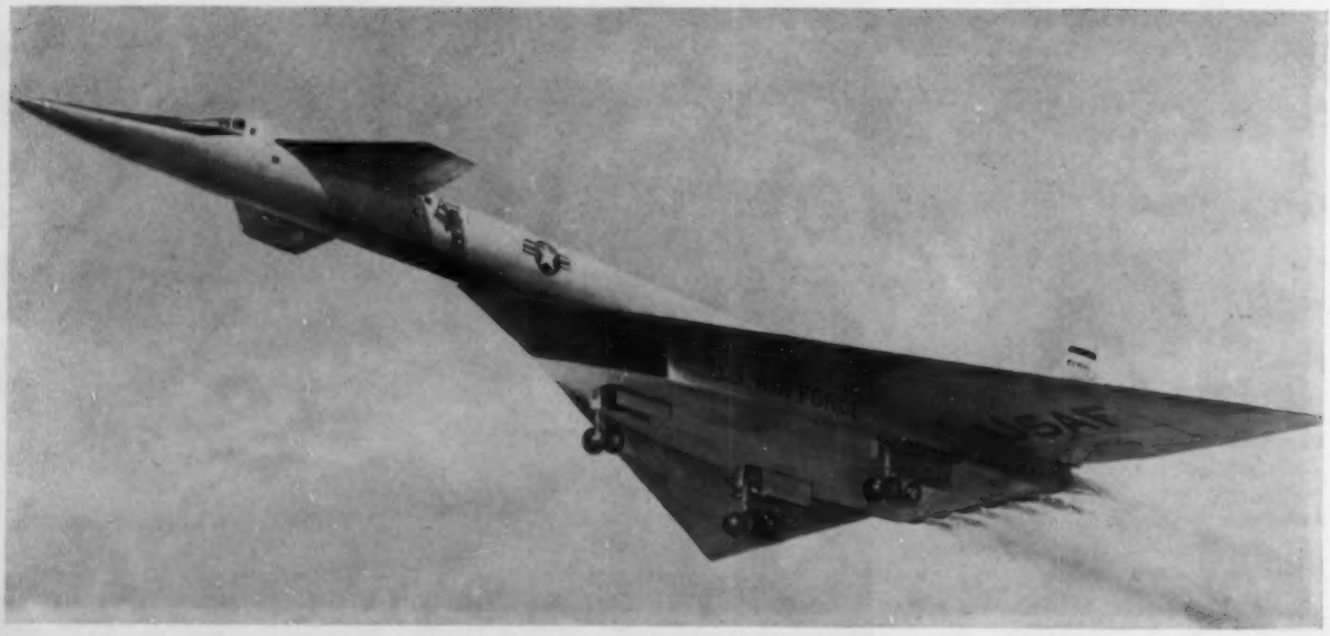
B-58 HUSTLER

Type: Strategic medium bomber.
Prime contractor: Convair Division of General Dynamics Corp.
Armament: Sky Bolts, three 20 mm. cannon; HE or nuclear bombs.
Performance: SPEED—Mach 2. CEILING — more than 60,000 ft. RANGE — "intercontinental through midair refueling."
Powerplant: CONTRACTOR—General Electric. TYPE—J-79. NUMBER—four.
Deployment: First operational squadrons are stationed at Carswell AFB, Tex.
Remarks: B-58 has been considered as a carrier for Sky Bolts but this has yet to be decided.

B-70 VALKYRIE

Type: Strategic bomber.
Prime contractor: North American Aviation, Inc.
Armament: Sky Bolts; nuclear bombs.
Performance: SPEED—Mach 3. CEILING — more than 70,000 ft. RANGE—intercontinental.
Powerplant: CONTRACTOR—General Electric. TYPE—J-93 turbojets. NUMBER—six.
Deployment: Possibly 1965.
Remarks: The B-70 program has been reinstated as a full R&D project.

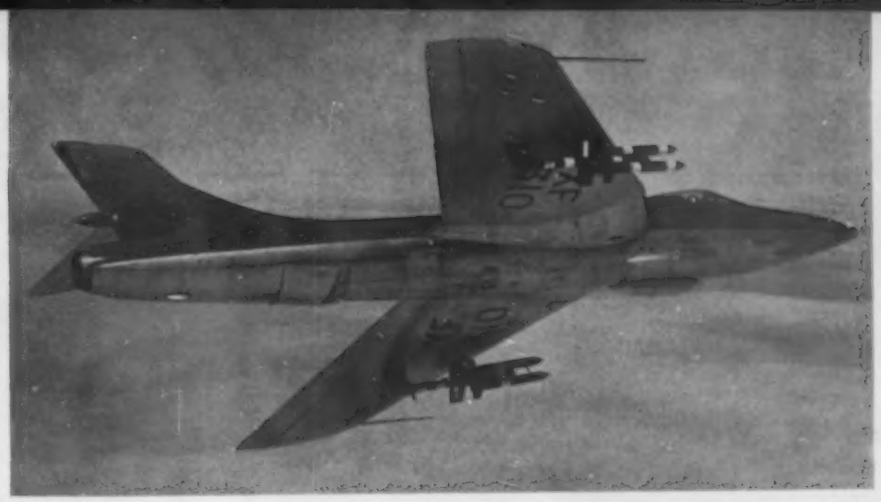
B-70 VALKYRIE



Great Britain

HUNTER F.6

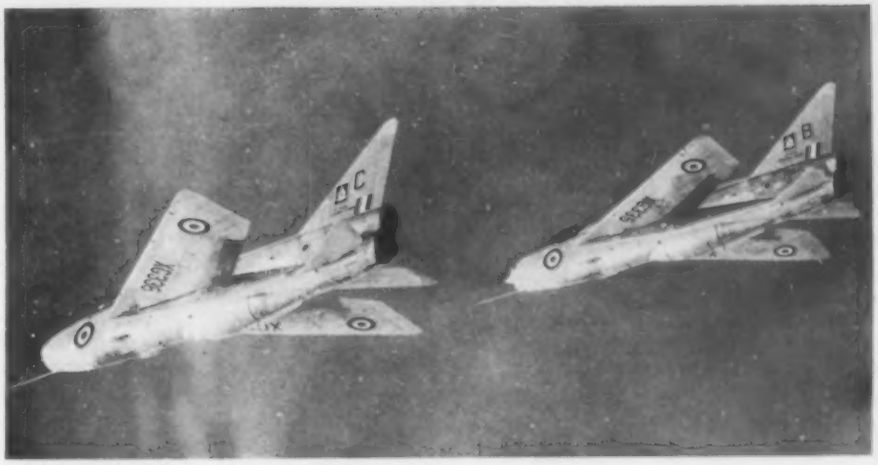
Type: Interceptor, fighter.
Prime contractor: Hawker.
Armament: Fireflashes; 24 3 in. rockets; four 30 mm. cannon; four 500 lb. or 1000 lb. bombs.
Performance: SPEED—more than 700 mph. CEILING—55,000 ft. RANGE—550 miles.
Powerplant: CONTRACTOR—Rolls Royce. TYPE—Avon 200.
Deployment: RAF bases in Britain.



HUNTER

LIGHTNING P.1

Type: Interceptor, fighter.
Prime contractor: English Electric.
Armament: Two Firestreaks, two 30 mm. cannon.
Performance: SPEED—more than Mach 2. CEILING—more than 60,000 ft. RANGE—not available.
Powerplant: CONTRACTOR—Rolls Royce. TYPE—Avon R.A. 24R turbojets. NUMBER—two.
Deployment: RAF fighter squadrons in Britain.



LIGHTNING

VULCAN B.2

Type: Long-range medium bomber.
Prime contractor: Avro.
Armament: Sky Bolts; HE or nuclear bombs.
Performance: SPEED—about 630 mph. CEILING—about 60,000 ft. RANGE—more than 3000 miles.
Powerplant: CONTRACTOR—Bristol. TYPE—Olympus 201. NUMBER—four.
Deployment: RAF bases in Britain.

VULCAN

VICTOR

VICTOR B.2

Type: Long-range medium bomber.
Prime contractor: Handley-Page.
Armament: Sky Bolts; HE or nuclear bombs.
Performance: SPEED—more than 600 mph. CEILING—50,000 ft. RANGE—more than 3000 miles.
Powerplant: CONTRACTOR—Rolls Royce. TYPE—Conway R. Co. II. turbojets. NUMBER—four.
Remarks: Victor B.1's are deployed at RAF bases.

MYSTERE

MIRAGE

France

VAUTOUR

Type: Fighter.
Prime contractor: Sud-Aviation.
Armament: Four MATRA 5103's or 511's or four missile pods containing 19 folding fin rockets each; four 30 mm. cannon; two MATRA packs containing 232 68 mm. SNEB folding fin rockets; some models carry bombs.
Performance: SPEED—686 mph. CEILING—44,000 ft. RANGE—3700 miles.
Powerplant: CONTRACTOR—SNECMA. TYPE—Atar 101E-3 turbojets. NUMBER—two.
Deployment: French Air Force.

SUPER MYSTERE

MYSTERE IV-A

Type: Interceptor, fighter.
Prime contractor: Dassault.
Armament: MATRA magazine with 55 rockets; two groups of 6 air-to-ground rockets.
Performance: SPEED—695 mph. CEILING—not available. RANGE—not available.
Powerplant: TYPE—Verdon 350.
Deployment: Ordered by French and Indian Air Force

MIRAGE III-A

Type: Interceptor, fighter.
Prime contractor: Dassault.
Armament: Two MATRAS; two 30 mm. cannon; one 5103 or R530 missile; two 1000 lb. bombs.
Performance: SPEED—Mach 2. CEILING—more than 70,000 ft. RANGE—not available.
Powerplant: CONTRACTOR—SNECMA/SEPR. TYPE—Atar 9 and SEPR 84. NUMBER—one of each.
Deployment: French Air Force units.

SUPER MYSTERE B2

Type: Interceptor, fighter.
Prime contractor: Dassault.
Armament: Two R-511's or AA 10's, two 30 mm. cannon, 35-rocket pack.
Performance: SPEED—743 mph. CEILING—55,000 ft. RANGE—not available.
Powerplant: CONTRACTOR—SNECMA. TYPE—Atar 101G.
Deployment: Operational with French Air Force.

BISON

BEAR

Soviet Union

BEAR TU-95

Type: Long-range heavy bomber.
Designer: Tupolev.
Armament: Possibly Komet D's or advanced models; paired 23 mm. cannon and one fixed cannon; HE or nuclear bombs.
Performance: SPEED—about 620 mph. CEILING—more than 36,000 ft. RANGE—4300 miles (with maximum load).
Powerplant: DESIGNER—Kutsnetsov. TYPE—K turboprops. NUMBER—four.
Deployment: Operational with DA, the Soviet Strategic Air Command.

BISON

Type: Long-range heavy bomber.
Designer: Ilyushin.
Armament: Possibly Komet D's or advanced models; one fixed and pair of 23 mm. cannon; HE or nuclear bombs.
Performance: SPEED—about 620 mph. CEILING—about 40,000 ft. RANGE—7000 miles (10,000 lb. bomb load), 3000 miles (20,000 lb. bomb load).
Powerplant: DESIGNER—Mikulin-Zubets. TYPE—turbojets. NUMBER—four.
Deployment: DA.

BADGER TU-16

Type: Long-range medium bomber.
Designer: Tupolev.
Armament: Possibly Komet D's or advanced models; paired 23 mm. cannon and one fixed 20 mm. cannon; HE or nuclear bombs.
Performance: SPEED—about 620 mph. CEILING—more than 40,000 ft. RANGE—more than 4000 miles.
Powerplant: DESIGNER—Mikulin-Zubets. TYPE—turbojets. NUMBER—two.
Deployment: DA.

BOUNDER

Type: Medium strategic bomber.
Armament: Komet D's or possibly advanced models; nuclear bombs.
Performance: SPEED—Mach 2. CEILING—about 60,000 ft. RANGE—not available.
Powerplant: TYPE—turbojets. NUMBER—four.
Remarks: The Russians are reported to have produced a small number of Bounders. The plane is reported to have been used as a test bed for nuclear aircraft powerplants as well as being deployed with DA. The Bounder is considered a Soviet counterpart to the U.S. B-58.

YAK-42 BACKFIN

Type: Fighter bomber.
Designer: Yakolev.
Armament: Six 105 mm. rockets; possibly M-100A's; 37 mm. tail cannon; nuclear or HE bombs.
Performance: SPEED—Mach 1.2. CEILING—more than 60,000 ft. RANGE—probably about 1500 miles.
Powerplant: TYPE—AM-3 turbojet. NUMBER—two.
Deployment: Soviet Air Force.
Remarks: The Backfin along with the IL-140 Blowlamp is reported to be replacing the subsonic IL-28 Beagle.

YAK-42 BACKFIN

Courtesy of Aviation Magazine, Paris, France

MIG-19 FARMER

Courtesy of Aviation Magazine, Paris, France

IL-28 BEAGLE

Courtesy of Aviation Magazine, Paris, France

G.91

MIG-19 FARMER

Type: Interceptor, fighter.
Designer: Mikoyan and Gurevich
Armament: 32 folding fin air-to-air rockets; probably M-100A's; one 37 mm. cannon; one 23 mm. cannon.
Performance: SPEED—about 925 mph. CEILING—58,000 ft. RANGE—1000 miles.
Powerplant: DESIGNER—A. M. Lyulka. TYPE—turbojets. NUMBER—two.
Deployment: Soviet interceptor squadrons; also Sino-Soviet Bloc nations.

IL-28 BEAGLE

Type: Fighter bomber.
Designer: Ilyushin.
Armament: Possibly air-to-air, air-to-surface missiles, in later versions. Reported to be capable of carrying more than 6000 lbs. of bombs.
Performance: SPEED—nearly 600 mph. maximum. CEILING—about 40,000 ft. RANGE—about 1500 miles.
Powerplant: TYPE—VK-1 turbojets. NUMBER—two.
Deployment: Soviet Air Force. Also the Air Forces of many of the Soviet satellite nations and Red China.

Italy

G.91

Type: Fighter.
Prime contractor: Fiat.
Armament: 5103's, air-to-surface rocket packs; 2000 lbs. of bombs.
Performance: SPEED—675 mph. CEILING—not available. RANGE—350 miles.
Powerplant: CONTRACTOR—Bristol. TYPE—Orpheus 3.
Deployment: Italian Air Force.

Sweden

A32A LANSEN

Type: Fighter.
Prime contractor: Saab.
Armament: Sidewinders or Robot 304's, bombs, rockets.
Performance: SPEED—700 mph. CEILING—not available. RANGE—2000 miles.
Powerplant: CONTRACTOR—SFA. TYPE—RM-5 (Avon).
Deployment: Royal Swedish Air Force.

A32A LANSEN

J35A DRAKEN

Type: Fighter.
Prime contractor: Saab.
Armament: Two to four Sidewinders; two 30 mm cannon.
Performance: SPEED—more than 990 mph. CEILING—55,000 ft. RANGE—not available.
Powerplant: CONTRACTOR—SFA. TYPE—RM6 (Avon).
Deployment: Royal Swedish Air Force.

J35A DRAKEN

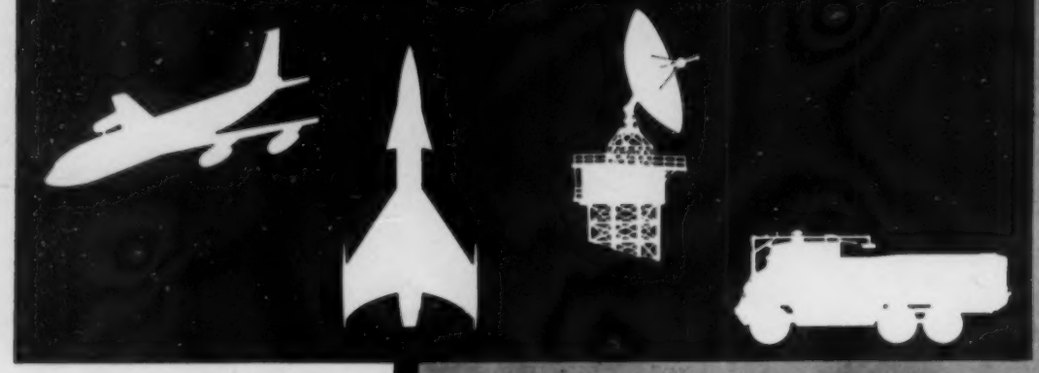
Switzerland

VAMPIRE

Type: Trainer or fighter.
Prime contractor: De Havilland of Great Britain.
Armament: Clusters of folding fin rockets; four 20 mm. cannon.
Performance: SPEED—more than 500 mph. CEILING—more than 40,000 ft. RANGE—more than 800 miles.
Powerplant: CONTRACTOR—D. H. Goblin. TYPE—turbojet.
Deployment: Many European, Asian and South American Air Forces; an advanced trainer in Great Britain.

VAMPIRE

WHICH PICTURE FITS YOU BEST?



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Technical Countdown

PROPULSION

Discriminating Control Needed for Saturn

The biggest unsolved problem in *Saturn* is developing a reliable device that will stop a malperforming engine every time—but not stop a good engine. If one engine fails, fuel is diverted to the other seven and the guidance equipment makes compensating thrust-alignment changes to successfully continue the mission.

Near-Vacuum Startup Poses Problems

The problem of startup in near-vacuum conditions is still plaguing designers of upper-stage hydrogen-oxygen engines for *Centaur* and *Saturn*. The H-O propellant combination is harder to ignite than LOX-kerosene.

Saturn Mating Schedule Changed

Only the first of each series of three *Saturn* vehicles will be mated at Huntsville before shipment to Canaveral. Previously, all ten vehicles in the development program were to come to Huntsville first.

Source Inspection to be Relaxed

The size of the *Saturn* program—much larger than any previously handled by Von Braun's Huntsville team—requires some relaxation of customary intensive in-factory supervision of component manufacture. But if quality falls, says *Saturn* boss Oswald Lange, a preferred list of vendors and fixed-fee contracts may be used.

ELECTRONICS

Big Future Seen for Electrostatic Gyro

Electrostatically supported gyros eventually will surpass conventional gyroscopes for missile use because of their precision, reliability, and small size and weight. General Electric's engineers made this prediction recently at the test labs of the company's Light Military Electronics Dept., after successful continuous operation of prototypes for over 100 hours. The frictionless units are expected to decrease gyro drift significantly.

Zeus Ground Computer To Be Tested

First *Nike-Zeus* target-intercept guidance computer has just been installed for test operation at the Army's White Sands Missile Range. Believed to be the fastest and most reliable ground-guidance computer developed to date, the prototype is continually self-checking and assists in fault isolation by module. Remington-Rand Univac and Bell Telephone Labs developed the system for the Ordnance Corps.

BMEWS-Thule Operational

First Ballistic Missile Early Warning station at Thule, Greenland, went operational last week. Operational responsibility was transferred to NORAD by the AF Electronic Systems Center, Bedford, Mass. A second site at Clear, Alaska, is scheduled to be ready by next summer, and the last station, in Yorkshire, England, will follow. From initial intercept to local computer to central control and display at NORAD-Colorado Springs, total time required should be less than 10 seconds, the Air Force says.

Radiation-Resistant Solar Cell Developed

A radiation-resistant solar cell—called the most striking advancement since production of the first cell in 1954—has been developed by the Army Signal Corps. The new solar cells resemble current types except that they are made of p-type silicone crystals infused with phosphorus.

Space Power Requirements to Increase

The next few years will see a rapid increase in electrical power requirements for space missions, according to Dr. Ernst Stuhlinger of NASA. He predicted that in about ten years space missions will require continuous power outputs of 300-500 kw.

Miniature Nuclear Powerplant Being Developed

A nuclear powerplant no bigger than a watermelon is under development at General Electric. The compact unit will produce 5-30 kw of electricity for use in satellites and manned space vehicles. Thermionic cells are used to convert nuclear heat energy from pellets of uranium or plutonium directly to useful electrical power.

GROUND SUPPORT EQUIPMENT

Cape Survey Best Ever

The ground survey performed recently at Cape Canaveral for a new missile-tracking network achieved the greatest accuracy ever for any earth measurement, Error was less than 1/16 inch to a mile. The task was accomplished over a 4000-sq.-mile area encompassing nine new sites for tracking cameras. Coast and Geodetic Survey scientists who did the job bettered Air Force requirements by a factor of 2.5 in achieving an accuracy of better than 1 part in a million.

New Smear Camera Revealed

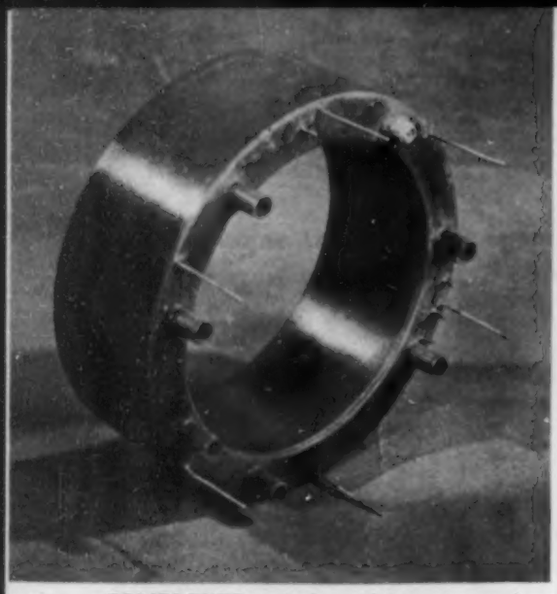
An ultrahigh-speed framing camera designed by Tsuneyoshi Uyemurra of Tokyo University permits continuous operation at 100,000 frames/sec. Two hundred exposures per run with a 1-usec exposure time are achieved using a 4-face rotating mirror. System will be described at 5th International Congress on High-Speed Photography in Washington, D.C. (Oct. 20).

Woomera DSIF Almost Complete

The second unit in the NASA/JPL world-wide deep-space instrumentation facility (DSIF) is due to go into operation at Woomera, Australia, by Nov. 1. The 85-ft. tracking antenna is complete and last units of electronic equipment are being installed. A third site, at Krugersdorp, South Africa, is due for completion next year.

Decision on Saturn Pad Delayed

No final decision has been made on whether a third *Saturn* launch complex—included in NASA construction plans for Canaveral—will actually be built. At Pt. Arguello, meanwhile, the space agency plans to build a central headquarters office to house about 35 administrative workers, a telemetry building, and a central storage and issue building.



COMPLETED unit formed into ring and encapsulated. Matrix can be wound or bent.

electronics

Automated Output Of Circuits Approaches

GE's welded-wire matrix is key to new process for tape-controlled fabrication

by Hal Gettings

UTICA, N.Y.—Completely automatic production of electronic circuits —from design to final test—may not be too far in the future. Some of the necessary machines are already available commercially. Others are being built. And the remainder appear feasible to engineers working on the problem.

General Electric (Light Military Electronics Dept.) this month put into operation one of the major elements of an automated system. This is a computer-controlled fabrication machine that can turn out 30 feet of welded-wire circuit matrix per hour. With the computer/machine combination, a breadboard matrix can be produced in something like 90 minutes—as compared to days for a printed-wiring breadboard.

GE feels that the welded-wire matrix (or WWM) lends itself to automated manufacturing better than any other similar method. For example, the layout of printed-wiring boards by computer is complicated by crossover problems. The matrix has unlimited crossover possibilities. In addition, it offers advantages in size reduction, reliability, ruggedness, and flexibility. It is adaptable to microminiaturized components and solid-state circuits.

• **WWM not new**—The matrix idea is not really new. An original patent was granted in 1934 but, so far as is known, was never applied. Samuel A. Francis, of Francis Associates, received a patent on certain variations of the matrix design in 1959, and his company used the technique in construction of prototype *Polaris* guidance computers. GE is presently using matrix circuitry in production models of the *Polaris* computer and for other applications, and has applied for patents on new methods of construction.

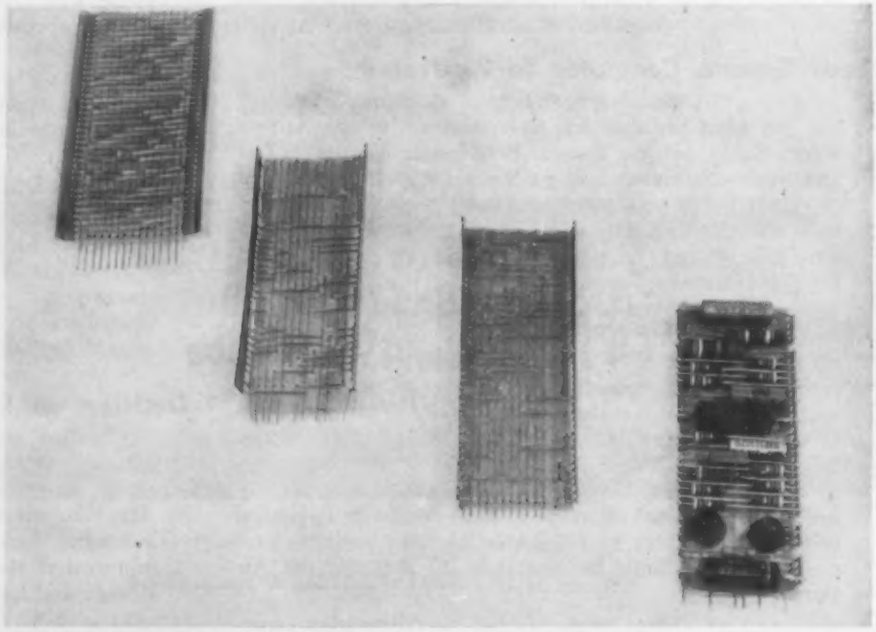
The welded-wire matrix is composed of two layers of parallel wires separated by a thin insulating sheet. One layer of wires runs lengthwise and the other transverse to the matrix ribbon. Grid increments may be as small as 0.05-in.

Interconnections between wires in the two layers are made by welding at desired intersection points. Insulation at these points is burned away by the welding heat. Components can be welded directly to the matrix wires or welded (or soldered) to terminal strips along the sides of the matrix ribbon.

• **Computer design next step** — Computer design and machine fabrication are only now being applied. Although a completely automatic production line is still some time off, GE is approaching this goal. Its just-completed fabrication machine can produce both breadboard and production quantities of the matrix ribbon. The only remaining elements to be built are a component placing machine and an automatic tester.

In production operation, information from a schematic is prepared by engineering on a form specified by standards, and sent to the computer group. This information will be punched into a paper tape which is fed to a computer. Operating on a program suitable for all circuits, the computer will lay out the matrix, taking full account of the size of components, lead location, required electrical connections, critical nodes (or junction points) and other considerations.

(As an example of the speed of operation of the computer, an electronic circuit containing 79 components was reduced to matrix form in nine minutes



CONSTRUCTION BEGINS with welding interconnections between horizontal and vertical wires (left). Unwanted wires are clipped, insulation applied, and parts soldered.

of computer time. Of the nine minutes, one was required to feed the tape into the computer, three to lay out and wire up the matrix, and five to punch the output tape.)

The output tape is fed to a printer, which in 15 minutes produces a sheet showing the location of components in proper staggered positions and the interconnection pattern for the matrix. The time for print-out can be reduced to less than five minutes when a mag-tape system and a high speed printer are available.

• **Simple languages**—The printed sheet provides a visual picture of the matrix layout. A repetition of dashes represents transverse wires; repeated figure one (1) represents longitudinal wires. The character X designates weld points. Components and node symbols are listed at the left of the sheet. After inspection, changes in the layout may be made by an editorial routine available to instruct the computer to make the change.

The paper tape output of the computer can be fed to a translator to produce a number of specialized tapes. One tape controls a drafting machine which produces drawings of the matrix for the customer. Another controls the fabrication machine which welds the interconnections.

Superfluous wiring in the matrix is automatically cut out by the fabrication machine. Components are soldered (or welded) in place by a technician according to the computer tape diagram. The completed circuit can be encapsulated, mounted on metal or plastic plates, or incorporated in other circuitry.

• **Configuration changed easily**—The automatic fabrication machine is designed to fabricate any matrix from one to fourteen longitudinal wires wide with a minimum of setup time. Within a given width, only the punched paper control tape need be changed to obtain a different circuit configuration.

Substantial lengths of wire and insulating sheet are carried on reels in the machine, making individual matrices of extended lengths possible. By forming the control tape in a loop the machine can be made to repeat one matrix configuration to produce a quantity of identical assemblies.

• **Resistance welding?**—GE will release no information on the type of welding used, other than to say that it's new. Resistance welding has been used in other cases and it's assumed that this or some variation of it is probably the basis of the GE method. The company has developed a special welding control for use with the machine which provides the necessary fast recovery time and pulse precision. Monitoring controls are also being developed to

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DWG.NO.  D763 1944
CONTROL SWITCHES NONE ON

                                  I I I   S S S       I I I
L-NODE  COMP  R-NODE              1 2 3   G 1 2       4 5 6
                                  1 1 1   1 1 1       1 1 1
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01 I2-----CR2 -09 01 ---X 1    1 1 1       1 1 1 X- 01
02 I3-CR3 -----09 02 -----X    1 1 1       1 1 1 X- 02
03 S1-----R2  -09 03 ---------1-X 1        1 1 1 X- 03
04 S2-CR9 -----09 04 ---------1-1-X        1 1 1 X- 04
05                05          1 1 1       1 1 1 1  05
06 SG-1       1-SG 06 ---------X-1-1-------1-1-1-1- 06
07 10-Q6  Q1  -09 07 -X         1 1 1       1 1 1 X- 07
08 11-3       3-07 08 -1---X    1 1 1       1 1 1 E- 08
09                09  1   1     1 1 1       1 1 1 1  09
10 08-R19 -----07 10 -1-X 1     1 1 1       1 1 1 X- 10
11 05-----C1  -07 11 -1-1-1-X 1 1 1         1 1 1 X- 11
12                12  1 1 1 1 1 1 1         1 1 1 1  12
13 08---L1  ---07 13 -1-X 1 1 1 1 1         1 1 1 X- 13
14                14  1 1 1 1 1 1 1         1 1 1    14
15 09-R6  -----S3 15 -1-X 1 1 1 1 1       X-1-1-1--- 15
16                16  1 1 1 1 1 1 1         1 1 1 1  16
17 08---C7  ---S3 17 -1-X 1 1 1 1 1       X-1-1-1--- 17
18                18  1   1 1 1 1 1         1 1 1 1  18
19 10-CR16-----I6 19 -X     1 1 1 1 1       1 1 1 X--- 19
20 10-----CR17-I5 20 -X     1 1 1 1 1       1 1 X----- 20
21 10-CR18-----I4 21 -X     1 1 1 1 1       1 X------- 21
22 10-----CR10-S2 22 -X     1 1 1 1 X-----1--------- 22
23 10-R18 -----S1 23 -X     1 1 1 X-------1--------- 23
24 11-----C6  -13 24 -----X 1 1               1   X----- 24
25 11-R20 -----12 25 -----X 1 1               1   1   X- 25
26                26       1 1 1             1   1   1  26
27 11---L2  ---12 27 -----X 1 1               1   1   X- 27
28                28         1 1             1   1   1  28
29 S3-R15 -----12 29 -------1-1---------X     1   X- 29
30                30         1 1             1   1   1  30
31 S3---C8  ---12 31 -------1-1---------X     1   X- 31
32                32           1 1           1   1      32
33 05-CR5 -----02 33 -------X 1               1   1 X--- 33
34 05-----CR6 -06 34 -------X 1               1   1 1 X- 34
35 13-CR14-----06 35 ---------1---------1---X 1 X- 35
36 14-----CR13-13 36 ---X       1       1   X-1-1- 36
37 04-R10 -----06 37 ---1---X 1         1     1 X- 37
38                38     1   1 1         1     1 1  38
39 SG---C4  ---06 39 ---1---1-X         1     1 X- 39
40                40     1   1           1     1    40
41 S3-R9  -----02 41 ---1---1-----------X     X--- 41
42 01-----C2  -02 42 -X 1   1           1     X--- 42
43 03-CR7 -----02 43 -1-1-X 1           1     X--- 43
44 03-----R8  -0A 44 -1-1-X 1 X---------1-----1--- 44
45 03-CR8 -----16 45 -1-1-X 1 1         1     1 X- 45
46                46  1 1   1 1         1     1 1  46
47 04-1       1-04 47 -1-1---X-1---------1-----1-1- 47
48 14-Q4  Q3  -02 48 -1-X     1 1         1     X-1- 48
49 01-3       3-16 49 -X 1    1 1         1       X- 49
50                50  1 1    1 1         1       1  50
51 04-R11 -----S3 51 -1-1---X 1           X-------1- 51
52                52  1 1    1 1         1       1  52
53 04---C3  ---S3 53 -1-1---X 1           X-------1- 53
54                54  1 1      1         1       1  54
55 14-C5  -----16 55 -1-X        1        1       X- 55
56 14-----R14 -S3 56 -1-X        1        X-------1- 56
57 14-CR12-----15 57 -1-X        1        1     X-1- 57
58 01-----CR11-15 58 -X          1        1     X-1- 58
59 01-R7  -----S5 59 -X    X---1---------1-----1-1- 59
60                60  1    1   1         1     1 1  60
61 0A-1       1-0N 61 -1---1---X X-------1-----1-1- 61
62 01-Q2  Q5  -16 62 -X    1    1 1       1     1 X- 62
63 S4-3       3-S4 63 -E---1---1-1-------1-----1-1- 63
64                64  1    1    1 1       1     1 1  64
65 0A-R5  -----S3 65 -1---1---X 1         X-----1-1- 65
66 S5-----R12 -16 66 -1---X     1 1       1     1 X- 66
67 0N-R13 -----15 67 -1---1---1-X         1     X--- 67
68 0N-----R16 -S3 68 -1---1---1-X         X--------- 68
69                69  1    1   1 1       1          69
                      1    1   1 1       1
                      S    S   0 0       S
      THE END         4    5   A N       3
```

COMPUTER LAYOUT TAPE shows physical layout. Left columns show component positions relative to numbered terminal strip. Diagram at right shows interconnection pattern. X marks indicate welds.

insure a high degree of reliability in the finished product.

Considerable research has been done by GE on welding techniques and the compatibility of components leads with this type of connection. A survey was made of component suppliers to determine most widely used materials, coatings, and other characteristics of leads. Samples were tested and a variety of welding machines evaluated. Thousands of test-joints were welded and pulled to destruction to obtain optimum settings.

Test results have provided an intermediate material with a composition and a configuration compatible with all components leads normally encountered. GE engineers see as the next step the development of lead materials specifically suited for the welding process.

ISA Meet Shows Interest In Underseas, Meteorology

NEW YORK—The prevailing trend of more and bigger advances in missile/space hardware, evident at all technical exhibits these days, continued at the 15th annual Instrument Society of America show held here recently.

But it failed to dominate the more traditional pneumatic, hydraulic, chemical and electrical instrumentations displayed for all of the other technological areas.

The conference papers, however, reflected the growing interest of the ISA in two expanding fields: underwater and meteorological instrumentation. A special panel session on "Automatic Landings on Earth and Planets" further demonstrated the effects of the missile/space age.

Some 30,000 persons were expected to view the more than 300 exhibits at the Coliseum during the five-day meeting. By mid-week, however it appeared that this figure was highly optimistic—registrations still numbered less than 18,000.

• **New advances described**—To better understand rapid changes in quality of underwater sound transmission, a field meter for continuous deep water measurement of sound velocity, depth (pressure) and water temperature has been developed and tested successfully.

Described in a paper by J. R. Lovett and S. H. Sessions of the Naval Ordnance Test Station, China Lake, the instrument is housed in a 70-lb. stainless steel cylinder, two feet long by six inches in diameter. It includes a tiny transceiver, a pair of thermistors and a vibrating wire pressure transducer. Rechargeable nickel-cad batteries permit eight-hour operation. Three multiplexed FM channels are transmitted through the single suspension cable, and sea water serves as return conductor.

Optron Corp. has developed a special electron tube, the Model 650, that is part of an optical device used to measure motion, vibration or displacement of an object. Used with an auxiliary telescope, it could serve for automatic control of tracking cinetheodolites. With a 40-in. focal length scope, tracking accuracies of ±10 sec. are possible with a resolution of .05 milliradian in a 10-milliradian field of view.

Statham Instruments, Inc., introduced a dime-size diaphragm absolute pressure transducer. For missile use, the tiny sensor features high-frequency response; ranges are 0-10 psia to 0-100 psia. Size is 0.590-in.-dia. by 0.050-in.-thick.

Electro-Optical Systems, Inc., described its new silicon whiskers used to provide 50 to 60 times more sensitivity than conventional transducers. One inch long by 0.5 mil dia., the whiskers are formed by etching or vapor deposition techniques. Called a Micro-sensor, the device manifests a piezoresistive effect when strained and provides a gage factor of nearly 130, compared to five for transducers of metallic construction.

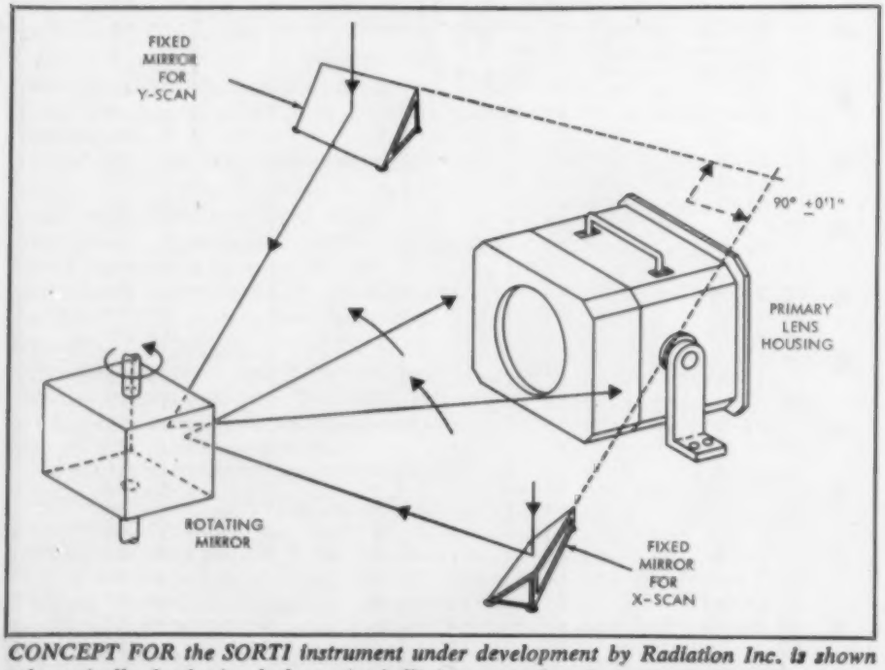
Instrument Development Laboratories, Inc., introduced its new Pyro-eye, an automatic two-color pyrometer. It

Contract Let for Real-Time Tracker

The Air Force has awarded Radiation Inc. a contract for development of the design for a "real time" missile tracking system. Announcement of the award confirms an earlier report in M/R (Aug. 22, p. 27).

To be known as SORTI (Star-Oriented Real-Time Tracking Instrument) the tracker will be the first to combine the high accuracy of the ballistic camera system with a real-time position tracking system, according to the company. This combination will provide immediate, accurate information, during flight, about a missile's path, and could make possible immediate analysis and possible in-flight corrections of the missile's trajectory.

The real-time position tracking system will utilize star positions for orientation reference. By incorporating electronic circuitry, SORTI will provide a method of overcoming present handicaps in trajectory tracking. It will retain the best features of the ballistic camera system.



CONCEPT FOR the SORTI instrument under development by Radiation Inc. is shown schematically. In the focal plane of a ballistic camera lens is a narrow slit with a photomultiplier detector tube behind it. A rotating mirror scans the sky alternately in x- and y-directions. A clock tied to the mirror rotation counts increments of angular measurement and its output is gated by the detector tube so as to provide an accurate reading of the angular displacement between two celestial light sources such as a missile and a known star.

Crib Mount Shields Atlas from Shock

Convair finds that the technique gives highest possible reliability against nuclear-weapon ground vibration

by George S. Rasmussen*

ISOLATING MISSILE systems from nuclear-weapon ground shock is one of the most important problems in the field of shock and vibration. The need for practical solution is immediate.

To provide a high degree of isolation from ground shock, low-frequency shock-mounting techniques with small rattle space must be developed. There are relatively few installations that can supply a very-low-frequency system for a large suspended mass.

The effect of the various shock isolation methods on total facility cost should be carefully weighed. If the best available method is used, the cost of shock isolation for a hardened system should be substantially less than 10% of total facility cost.

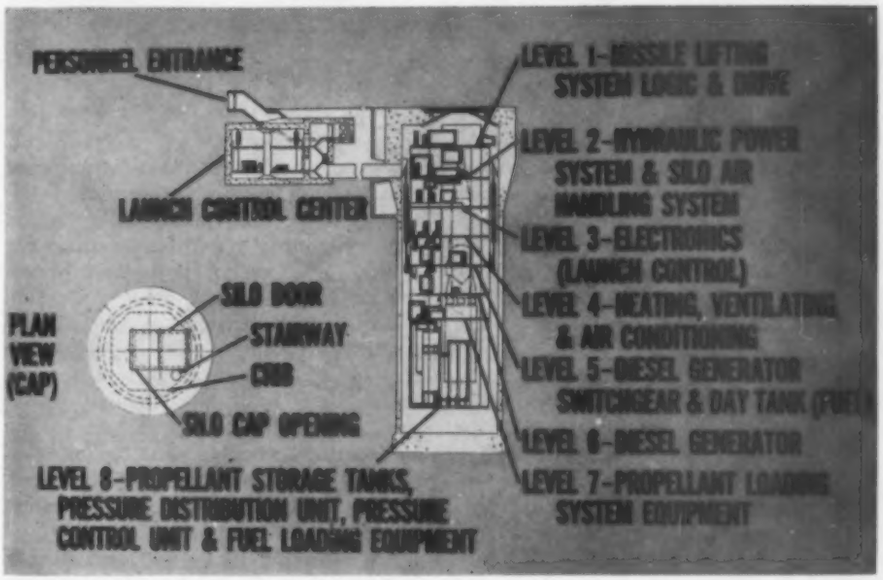
Whatever method is chosen, high reliability is essential: if only one out of 10 sites fails to accomplish a launch because of ineffective shock mounting, it proves that more money should have been spent for reliable isolation.

• **Best system**—A suspended crib provides the ultimate isolation for the entire weapon system. In such designs, the only connecting link is between the blockhouse and the missile/GSE enclosure.

Thus, all equipment can be rigidly attached to the crib structure and need not be designed to withstand high inertial loads. Only the rattle space of the crib itself has to be considered. Reliability is as high as can be attained in the shock environment.

Since the missile can be stored on the same crib as the GSE, only one enclosure is required. See the accompanying diagrams showing silo arrangements for *Atlas*. Since the personnel in the launch control center are on the same platform as the equipment, the vibration level can be reduced so that they require no further protection.

In the *Atlas* unitary silo, each shock strut contains seven spring cells in which there is a spring within a spring within a spring. Eliminating one or several springs permits locating the elastic center of the spring hangers at any point within 40 inches of the geometric center. Thus, the elastic center can be placed close to the c.g. to reduce the pitch response to vertical shock. These spring hangers are about 50 feet long and provide a lateral rigid-body vibration frequency of approximately 0.13 cps.


PERSONNEL ENTRANCE
LAUNCH CONTROL CENTER
PLAN VIEW (CAP)
SILO DOOR
STAIRWAY
CRIB
SILO CAP OPENING
LEVEL 1-MISSILE LIFTING SYSTEM LOGIC & DRIVE
LEVEL 2-HYDRAULIC POWER SYSTEM & SILO AIR HANDLING SYSTEM
LEVEL 3-ELECTRONICS (LAUNCH CONTROL)
LEVEL 4-HEATING, VENTILATING & AIR CONDITIONING
LEVEL 5-DIESEL GENERATOR SWITCHGEAR & DAY TANK (FUEL)
LEVEL 6-DIESEL GENERATOR
LEVEL 7-PROPELLANT LOADING SYSTEM EQUIPMENT
LEVEL 8-PROPELLANT STORAGE TANKS, PRESSURE DISTRIBUTION UNIT, PRESSURE CONTROL UNIT & FUEL LOADING EQUIPMENT

ATLAS UNITARY launch facility shown in a cutaway view.

This ultimate isolation does not come without certain disadvantages: The suspended mass may be tremendously large. The cost of a low-frequency mounting system for such a mass will increase significantly if the rigid-body vertical vibration frequency drops well below 1 cps.

The reason for the cost increase is that a low maintenance steel-spring system is not feasible for very-low-frequency applications; a hydraulic-pneumatic or some other similarly complex isolation system must be employed. Furthermore, a large rattle space is required for the low-frequency crib motion. However, floor space is less than that needed for palletization and individual shock-mounting.

The additional fabrication cost required for the crib may be balanced by the saving in the cost of equipment (no necessity for rugged equipment) and by the reduction in the construction cost of the enclosure.

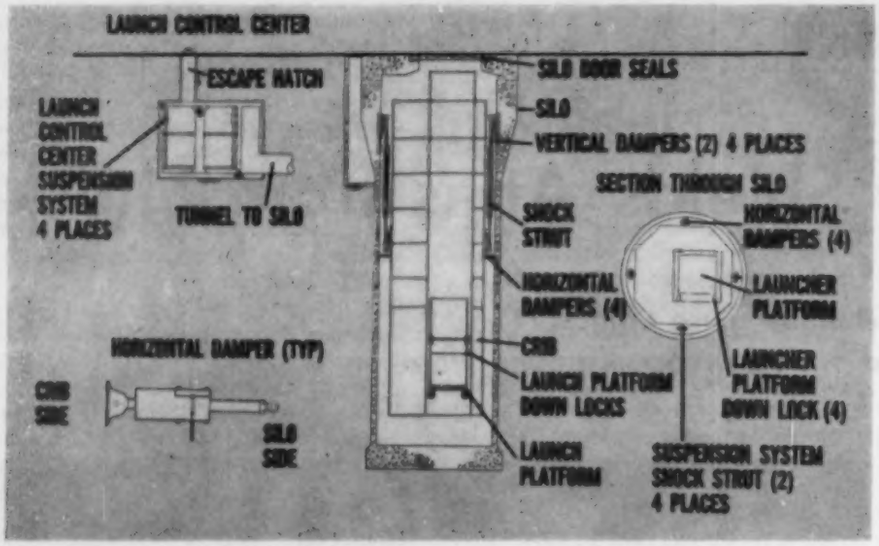
Limited design experience is the major problem with a shock-isolated crib. The design and fabrication of the crib and shock-mount structure must be closely controlled to make sure that the elastic response of the crib will be negligible and the desired rigid-body vibration characteristics attained.

• **Designing against shock**—A number of factors enter into the choice of a method of shock isolation. Primary is the severity of the shock environment.

For severe ground shocks, palletization and crib mounting are more desirable than shock-mounting individual items of equipment.

Many GSE items are designed to withstand not more than normal handling shocks; this is especially true for electronic equipment. Rapid-fill propellant loading systems are quite vul-

*Senior Research Engineer, Convair (Astronautics) Div., General Dynamics Corp., San Diego.



SUSPENSION SYSTEM shows struts and horizontal dampers for isolating Atlas crib.

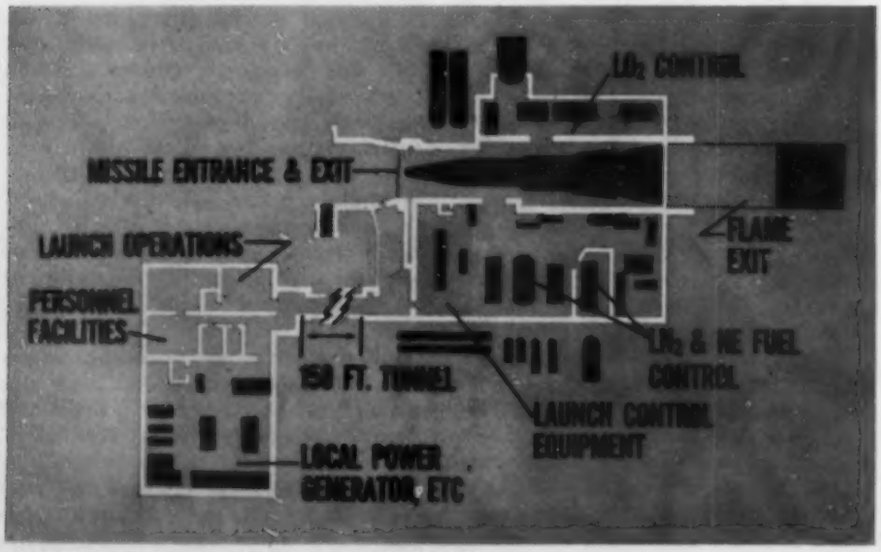
nerable to damage by ground shock. The electronic equipment and valves are fragile, and the long spans and bends of piping cannot withstand high inertial loads. High electronic cabinets can overturn or have electrical connections loosened as a result of a severe shock.

In general, shock-mounting individual items of equipment should be done only when the majority of the equipment is capable of withstanding the shock with standard mounts and mounting procedures. It is quite possible, however, that a combination of palletization and mounting of individual items could prove best for moderate environments.

For sites with horizontal missile storage, the best design approach appears to be complete isolation of the missile and its erection boom from the walls and floor of the shelter. Since the boom represents a flexible beam, dynamic deflections of the boom during ground shock may cause significant bending moments in the missile. Isolation of the boom and missile on the same mounting system can reduce the elastic deflection of both, and hence, the bending moments.

Sites with vertical missile storage require an isolated crib to protect the missile. If in-silo launch is not used, an elevator must be provided within the crib to bring the missile to the surface for launching. The flexibility of the crib should be considered; however, if the frequency of the fundamental mode of vibration is sufficiently high the assumption of a rigid crib can be justified. For flyout launch platforms this would certainly be the case.

It is expected that the critical shock and vibration environments to be used for the design of missile systems of the future will be those peculiar to the mobile carrier—ship, barge, railroad train, truck, trailer, etc.—in normal operation. ⁂



LAYOUT OF a coffin configuration for the Atlas.

Hound Dog Loading Time Slashed with New Facility

A new facility for loading *Hound Dog* missiles has sharply reduced shipping time at North American Aviation's Missile Division, Downey, Calif.

Wide enough to accommodate three trucks and 85 feet long, the loading facility is equipped with three mechanical dock levelers which automatically adjust to the height of the truck bed.

"We are saving at least a half-hour in loading each missile that we ship out," says Dale Haw, assistant traffic foreman at the Missile Division. Previously, he explained, the missiles had to be transported to the Autonetics Division for loading onto trucks from an above-ground cement ramp with the air of a winch.

"Now, three men can load the missile on the truck easily within five minutes," Haw says.

UE, SAAB Sign Contract For Swedish Range GSE

United Electrodynamics, Inc., Pasadena, has signed a contract with Sweden's SAAB Aircraft Co. under which the U.S. Firm will engineer and install ground telemetry equipment for a new Swedish missile range.

The cooperative agreement will support SAAB's program to develop a new air-to-air, air-to-ground missile somewhat similar in purpose to the U.S. *Sidewinder*.

Canadian RCA Firm Builds Detection System Circuits

Radio Corp. of America will shift an increasing amount of its defense business to its Canadian associate, RCA Victor Co., Ltd., President John L. Burns has told a Toronto audience.

The Canadian company has already taken on a $2-million order for equipment for an electronic detection and control system, part of the North American air defense.

The system involves the automatic transmission of information to *Bomarc* missiles and interceptor planes. The Canadian company will supply the security sealed circuits. They are compact, prefabricated panels with the wiring permanently etched in place, which have largely supplanted bulky, hand-soldered wiring in both military equipment and commercial electronics.

Mr. Burns noted that "as defense and space electronics has become more and more important, and as our U.S. defense business has grown, we have increasingly drawn our Canadian facilities into both the development and the production phases of this work."

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Puzzler: the 'Atmosphere' of Space

Study at Ohio State underlines dearth of data on how the space environment will treat materials; simulation is extremely difficult

THE SEVERE LIMITS of this country's knowledge in dealing with the "atmosphere" of space have been revealed in a study sponsored by the Ohio State University Research Foundation.

The project was executed by a group of scientists at National Research Corporation, Cambridge, Mass.; the basic contracting party was Materials Central, Wright Air Development Division, Wright-Patterson AFB.

The 67-page report concerned itself with the effects of the space environment on materials and pointed up a startling lack of existing fundamental knowledge.

Admittedly, no dire effects are realized when short-term, or relatively simple satellites are operating in space. But with the increasing emphasis on development of manned stations and complex probes, a more appreciative effort should be made to understand this hostile environment in relation to our demands on materials.

Some of the conclusions of the report are presented briefly here.

• **Nothingness on Earth**—The most comprehensive section of the study deals with the current status of vacuum technology—with respect to the problems in simulating the space environment and the types of demands that are made on vacuum pumping and measuring equipment.

Space is considerably more complex than it seems at first. The rarified gas environment that would surround a stationary vehicle is a low-density mixture consisting primarily of hydrogen and helium—and the gas molecular motion would be substantially random or isotropic.

Further, the temperature of these gases will not be the same because of infrequent collisions, and equilibrium may not be attained because of the competing radiative processes of energy transfer.

Also, there may be directed gas flows emanating from the sun superimposed on the random gas motion.

A vehicle could not remain stationary at a single point in space because of the presence of the gravitational fields of the sun and earth. The effect of the velocity of the vehicle relative to that of its surrounding environment must be added.

Another complication is that the vehicle itself is a source of gas. Molecules leaving the surface will travel directly away from it, with negligible chance of collision and return to the surface.

These molecules will have superimposed on them the translational velocity of the vehicle at the instant they are evolved.

• **Understanding the case**—The problem of simulation is obviously complex. Total simulation would be prohibitively expensive, even if it could be done. Usually, simulations are concerned only with studying specific effects and each situation determines the vacuum requirements.

The report points out that the capability of producing vacuums down to 10^{-9} mm Hg exists today. In the achievement of lower ultimate pressures, the limitations which must be overcome are substantially those which have been of primary concern in developing ultrahigh vacuum to its current state. These are relatively straightforward.

One area of major deficiency in current vacuum technology, insofar as ultrahigh vacuum suitability is concerned, is that of seals and feedthroughs.

In the process of bringing a chamber down to the desired pressure level, a certain amount of "baking" is necessary. To remain tight in the face of thermal cycling, thermal gradients, reasonable mechanical tolerances, warping due to stress annealing and the stress of mechanical closures gasket materials must be capable of being highly strained without exceeding the elastic limit. The construction of moderate-size seals has lead to the usage of rubber and other elastomers. The outgassing rates of these materials render them unsuitable for the extreme ultrahigh vacuum range.

This is illustrative of the complications in the other aspects of reaching pressure below the current state of the art.

As bad as it is, the vacuum effect of space cannot be considered by itself. As usual, nature refuses to be simple and tosses several other ingredients into the "normal" space environment.

• **Possibly synergistic?**—The study states that another of the major problems in space simulation is the confined effect of radiation and high vacuum on the characteristics of polymeric and oxide coatings. Information on this is almost non-existent in the 10^{-9} mm Hg range—the pressure of space.

Radiation—induced changes will be mainly due to ionization and excitation processes, because of the energy spectrum of the major constituent of space radiation.

These effects are generally proportional to the total energy absorbed by the materials regardless of the type or quality of radiation. In addition, the major proportion of the energy is absorbed in the outer skin. This last factor should make possible space irradiation simulation using a low-energy electron beam (300 kev and down) in a high-vacuum environment. High-energy beams will not simulate as closely because their influence on bulk effects would be greater than that expected of the real thing.

Such simulation should be in the 10^{-9} mm Hg range or lower and special consideration will have to be given to the outgassing problems enhanced by radiation degradation.

The report points out that while simulation is possible, it is not within the current state of knowledge to equate it exactly to a given lifetime. Continuing satellite and rocket experiments may resolve this problem.

The authors realize that there is a wealth of information on radiation effects—but the vacuum contribution has been practically ignored. The few data that are available caution that radiation effects observed in air, especially with organic materials, are not necessarily transposable to those effects which would be found in a vacuum.

• **Earth's envelope**—The vast ma-

jority of available data on the mechanical properties of materials was collected with little or no regard to the surrounding gaseous atmosphere or its pressure.

It is only in recent years that investigators have delved into these properties in the presence of a vacuum. As far as metals are concerned, the study concludes that the amount by which environments can effect their strength by altering the surface tension of a crack free surface is negligible except for the cases of very fine wires or extremely thin sheets.

The authors found that much of the data in the literature, especially in alloys, shows effects of environment directly attributable to gross composition or structure changes caused by diffusion of some element either into or out of, the specimen.

The large ratios reported for fatigue life in vacuum to that in air and other gases may become considerably larger when the tests are performed in ultra-high vacuums. The present results have been termed "astounding."

Another conclusion is the possibility that the growth of solid oxide in surface cracks is responsible for the relatively small effect of environment on rupture life and creep rate of nickel and nickel alloy rods.

The activity in vacuum mechanical testing included work accomplished at MIT, Naval Research Laboratories, U.S. Steel Corp. and National Research Corp. Progress in France and Britain is also mentioned.

A number of interesting conclusions are drawn from the field of high-vacuum friction.

In this area, the most important mechanism is permitting really clean metal-to-metal contact and subsequent cold welding. Lubrication thus becomes a factor.

The authors approached the problem from the physico-chemical barrier aspect to avoid confusion, since a number of mechanisms are involved in ordinary friction and wear processes. The one main theme in all of these is their dependence on some sort of physico-chemical means of inhibiting the welding between the microscopic asperities of relatively moving surfaces.

Bringing space into the picture adds a few more variables. The effects of friction must take into account the length of the mission, duration and degree of high-temperature exposure, radiation exposure and the dangers of contamination by condensation.

Some of the other points mentioned include:

–That low vapor pressure greases are available for use in vacuums up to 10 mm Hg.

–That dry films have been successful in lightly loaded anti-friction bearings at speeds up to 7000 rpm.

–That all of the information on vacuum lubrication has been gleaned from vacuum environments with pressures higher than 10^{-9} mm Hg. It is only below this pressure that surfaces stay "clean" for hours instead of minutes or seconds.

Very little is being done on gear lubrication, although this presents even more difficulty than many bearings. The only activity known to the authors, outside of a small project at National Research, is a series of tests run by Southwest Research Institute for WADC. These involved a full-scale rig under various inert gas atmospheres to simulate the absence of oxygen.

In the electrical and electronic properties of materials, knowledge of the effect of the real, or simulated, space environment is relatively poor.

Surface conductivity, spectral emissivity, photoelectric emission and optical transmission are all strongly surface-dependent properties.

Every physical component made on earth has a thin surface layer completely covering the bulk material of which it is made. To the extent to which these surface layers are easily removed (10^{-6} mm Hg at moderate temperatures) the effects have been explored somewhat, particularly in the areas of surface electrical conductivity, high voltage breakdown and radiant heat transfer.

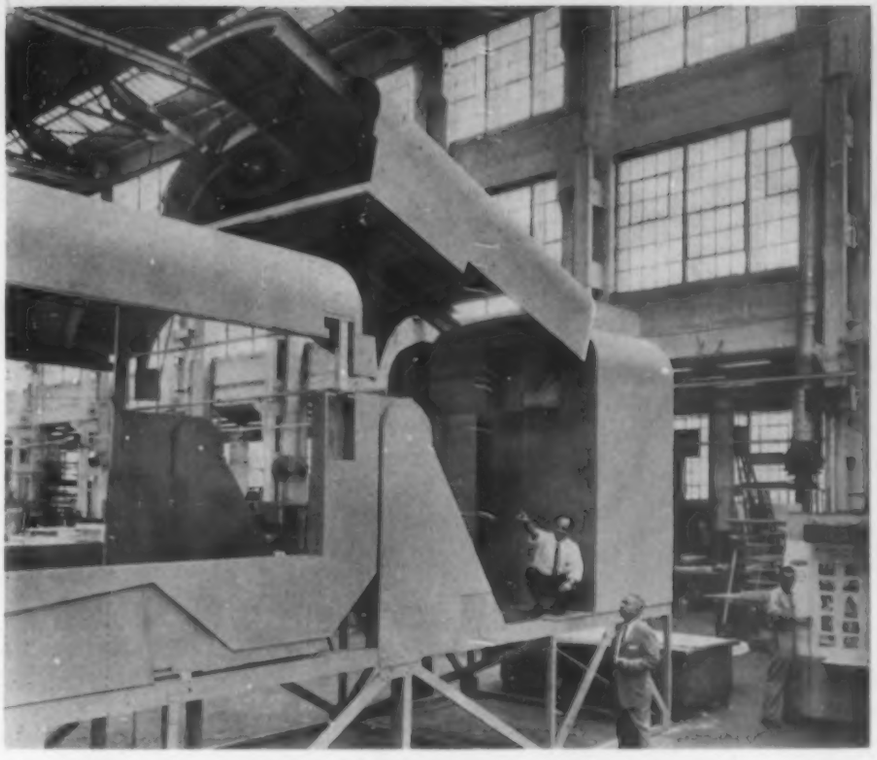
But practically none of this work has been concerned with the effect of vacuum as a variable. And less has been done in the study of ultra clean surfaces.

This is primarily due to the difficulty of providing an ultra-high vacuum in combination with radiation. The work that has been done was directed to ends other than the space environment, such as refractory filaments.

The effect of lack of gravity is mentioned only in passing, since there is no reason to assume that materials per se will be affected.

Meteoroids appear now not to offer any serious obstacles to the development of space vehicles, since adequate shielding may be achieved without punitive weight.

The study indicates that such things as the theoretical aspect of impact and a continuation of efforts to establish more rational state equations connecting stress, strain, temperature and strain rate for use in these studies. ⌗



Full-scale Minuteman Model

THIS WORKING-MODEL MOCKUP of the Minuteman railroad erector-launcher is expected to save considerable time and money in development of the operational carrier for the mobile ICBM. American Machine and Foundry, prime contractor for the train, says the three-dimensional full-scale model will give design engineers a much more realistic feel for the problems involved in the construction of this unique mobile launch pad. A commercial exhibit and display manufacturer—Ivel Construction Co., of New York—produced the 40-ft.-long, manually operated wooden mock-up in 18 days.

Performance of This New Accelerometer Is Spectacular!

And CEC's Type 4-202 Strain Gage Accelerometer is also the smallest on the market...measuring just one cubic inch.

Here are some of the performance characteristics that make the 4-202 infinitely superior to any other linear unbonded strain gage bi-directional accelerometer:

Its cross axis response is unusually low... its resonant frequency is unusually high – and there's extremely little damping change over a temperature range of −65°F to +250°F.

The 4-202 is the smallest temperature compensated instrument you'll find anywhere for measuring accelerations perpendicular to mounting surfaces. It's available now in a range of ±5g to ±500g.

For more information, write for Bulletin CEC 4202-X3.

Transducer Division CEC

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

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Deep Drawing

ACF Makes Big Steel Cups In Polaris Work

Solid rocket motor cases over six feet long with a single circumferential welded seam are possible through a unique metal working capability at ACF Industries, Inc.

The firm has successfully cold-deep-drawn high-strength steel sheets into cups 38 in. deep and 54 in. in diameter, in a second-stage *Polaris* missile advance test program.

Four forming passes in ACF's 4,000-ton press are necessary to completely shape the cup. After each deep drawing step, the workpiece is process-annealed and specially prepared in a seven-tank phos-lube line.

The phos-lube process, largest in the free world, treats the metal with a phosphate coating which acts as a host for the lubricant. This prevents metal-to-metal contact between the workpiece and the forming dies.

The press itself has a 120-in. stroke, 168 in. of daylight and a column clearance of 92 by 160 in.

The process begins with the sheet circles, 108 in. diameter and 0.080 in. thick, moving through a simple, straight draw. This results in a shallow cup 12 in. deep and 85 in. in diameter.

After phos-lube treatment, an initial reduction draw deepens the cup by 3 in. and reduces the diameter to 76 in. A second reduction draw extends the depth to 20 in. with a diameter of 68 in. The final reduction draw produces a cup exceeding 38 in. in depth with a diameter of approximately 54 in.

According to Donald B. Howard, ACF Staff Metallurgist, the most critical part of the operation is keeping the thickness and hardness uniform. Electronic micrometer checks show that the thickness tolerance of 0.010 in. is achieved.

In some cases, ACF has reverse deep drawn the final cup.

Two steels were involved in the program. U.S. Steel's X200 and MX-2, a high-strength alloy steel developed by the Mellon Institute of Philadelphia for the Navy.

Technique Simulates Case Cracks Non-destructively

Cracks which closely resemble those occurring in rocket cases are being simulated at the Stanford Research Institute, for Aerojet-General Corp.

The project called for a nondestructive means of determining how big a crack in a case could be tolerated before it caused a missile failure.

In the past missile cases were tested by pressure tests. The trouble was that

← Circle No. 13 on Subscriber Service Card.

the tests themselves increased the cracks. When launch time came, the missile might fail because of a relatively harmless crack enlarged by repeated testing.

Metallurgist Alfred Neiman and physicist Ernest Chilton of SRI went to work on the problem. They found out that they could not etch a crack, since this would cause non-normal conditions in the metal around the area. And they had to be able to reproduce cracks of certain dimensions.

The SRI team's answer was to spark-machine a thin slot into the metal, then dip it into liquid nitrogen. When the steel drops to the liquid nitrogen temperature the piece is put into a holder. A steel stud with a blank cartridge is fired against the sheet on the side opposite the slit, producing the crack. By machining the same size slit, and firing the same charge bullet, the crack size can be reproduced.

By analytical methods the team is determining what loads or stresses cause certain size cracks, and what loads enlarge the crack so that it causes a missile case failure.

Amphenol-Borg Begins Big Plant Expansion Program

Amphenol-Borg Electronics Corp. will sink $4.5 million into plant expansions during the next year.

Construction will begin immediately on a 125,000-sq.-ft. addition to the Amphenol Connector Division plant in Broadview, Ill. The $1 million building will house the Punch Press department now located in Cicero, Ill., and assembly operations at another location in Chicago.

By May, 1961, a new 60,000-sq.-ft. building for the Amphenol Distributor Division will be completed. Cost is estimated at $560,000.

Borg Fabric Division plant in Jefferson, Wis., will get a 47,000-sq.-ft. addition.

Amphenol-Western Division has purchased a 2½-acre plot adjoining its present Chatsworth, Calif., site. A 45,000-sq.-ft. plant addition will bring expense there to $475,000.

Amphenol's wholly owned subsidiary in Great Britain will move its electronics components operations to a new $500,000 facility being built at Whitstable in Kent, 54 miles from London. Construction of a $1.3-million second factory for fabric manufacture is also under way at Whitstable.

The company also has plans to acquire facilities in the New York City area to house the newly created Amphenol-Eastern Connector Division.

The program will be financed from earnings, current available cash and debt financing.

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CEC makes them precise...

Type 4-312A Pressure Transducer

Type 4-313A Pressure Transducer

Versatility makes them popular

4-001 Closed-line Adapter

4-008 Chamber-type Adapter

For adaptability in pressure measurement, there's no equal to the pair of unbonded strain-gage instruments pictured here actual size. With adapters they can be flush-mounted... chamber-mounted... water-cooled... water-proofed.

A workhorse with a thousand uses, Type 4-313A is available in absolute and gage models that measure pressures from 100 to 5000 psi in a temperature range of −100°F. to +300°F.—with superior performance in shock and vibration environments. The unit mates with a 4-008 chamber-type adapter as well as with an adapter for use in closed-line pressure measurements.

Type 4-312A, available in absolute, gage and differential models, is a general purpose transducer particularly suited to aerodynamic pressure studies. It operates in a range of 10 to 150 psi in gage, absolute and unidirectional models and from ±5 to ±50 psi in differential models. Used with a 4-001 adapter, it is ideal for closed-line applications.

Call or write for complete information. Ask for Bulletin CEC 1541-X1, Type 4-313A; Bulletin CEC 1540-X1, Type 4-312A; Bulletin CEC 1558-X1, Adapters.

Transducer Division CEC

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

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hardware job now . . .

Era of Space Communications Begins

Courier can handle 3.5 million words per day; paves way for more sophisticated 24-hour Advent system

The successful orbiting of *Courier 1*—the world's first active communications satellite—appears to have erased all doubts as to the technical feasibility of establishing a space communications system.

As one electronics expert put it: "It's a hardware job from here on."

A two-stage *Thor-AbleStar* launched the 500-pound *Courier 1* satellite into orbit from Cape Canaveral at 1:50 P.M. EDT Oct. 4—third anniversary of the launching of *Sputnik I*. The 106.9-minute orbit had a perigee of 602 miles, an apogee of 752 miles.

On its first orbit the delayed repeater satellite transmitted a message from President Eisenhower in Washington to U.N. President Frederick Boland in New York. The message was transmitted from Fort Monmouth, N.J., to the satellite and relayed to Puerto Rico. Then it was transmitted back to Washington and sent to the U.N. by regular communications channels.

Courier I's success opened the way for establishing both military and commercial global satellite TV and radio networks. It also paved the way for Project *Advent*—the Army's advanced system of one-ton, 24-hour communications satellites.

Courier is capable of handling almost 3.5 million words per day—the equivalent of the wordage contained in 465 standard-size newspaper pages. This capacity is based on a 5-kilobit-per-second information rate (average word is equal to 44.4 bits).

• **Complex package**—*Courier* is the most complex and sophisticated communications system ever put in a small package. It can function either as a delayed-repeater station or as a real-time relay. It will provide 20 continuously available 100-wpm teletype channels or, alternately, low-priority voice channels.

The satellite contains four separate systems: VHF link, microwave link; telemetry system, and radio beacon. Most of the circuitry and equipment is duplicated to achieve a high degree of reliability.

• **Operates only on command**—*Courier* provides a relatively secure method of communications. It must receive a properly coded signal before accepting or transmitting traffic. Also, due to position requirements, reception, interception and jamming pose difficult problems for an "enemy" station.

In orbit, the satellite transmits a low-powered acquisition signal. On acquiring this signal, the ground station transmits a coded command to switch the satellite from standby to active operation. The acquisition transmitter is switched off and the VHF telemetry transmitter begins sending data to the ground station. The satellite acknowledges receipt of the first command and begins microwave transmission, which provides a beam for automatic tracking by the ground antennas. Subsequent commands to the space station are made via the microwave link.

Each command is preceded by a coded signal which is changed according to a predetermined pattern. In case the signal is lost, the satellite automatically returns to the standby mode and the operational sequence may be repeated.

COURIER package is most sophisticated of small size ever produced. Circuitry and equipment are mostly duplicated.

Data relay is accomplished during the 10-15 minute period in which the satellite is within range of the ground station. At the end of this period, it is commanded to return to standby.

As the satellite passes over the next station, virtually the same procedure is followed to acquire and command. Upon receipt of the proper code, data received earlier is played back and transmitted to the ground. The ground station may transmit traffic for further relay at the same time it is receiving messages.

• **VHF link**—The VHF link (100-150 mc) is used for initial acquisition and telemetering. Equipment in the satellite includes two 50-mw acquisition transmitters, two 1.5-watt telemetry transmitters, two command receivers, diplexer, and antenna.

The ground station is equipped with one 100-watt transmitter, two receivers, and a tracking antenna. The antenna has an 18° beamwidth and 18 db gain. The two receivers operate together to provide quick polarization.

• **Microwave link**—Messages and operational commands are carried by the microwave link (1.7-2.3 km). The satellite contains four 5-watt transmitters, four receivers, one receiver baseband combiner, and two antennas for handling traffic at these frequencies.

In the active mode, two of the transmitters—tuned to slightly different frequencies and connected to separate antennas—operate at one time. All four receivers operate at the same time. The baseband combiner accepts the output signal from the receiver with the most favorable signal-to-noise ratio.

On the ground, the microwave equipment includes one transmitter, four receivers, one receiver baseband combiner, and an antenna. The antenna is the same 28-footer used for the VHF link. Beamwidth is 1.3 de-

grees and gain 42 db. Ground receivers operate together to provide polarization and frequency diversity. Outputs are combined to provide a single baseband output.

• **Telemetering system**—The telemetering system performs two functions: monitoring internal conditions in the satellite, and acknowledging commands received.

• **Ground stations**—The *Courier* system at present uses two ground stations; near Ponce, Puerto Rico, and Ft. Monmouth, N.J.—both Army Signal Corps installations. Other stations will be added as the project progresses to provide a truly global system.

Courier's Vital Statistics

Payload weight	500 lb. (approx.)
Payload size	51 in. diameter
Satellite spin rate	40 rpm (approx.)
Orbit	602-752 mi. (approx.)
Satellite speed	14,400 mph (approx.)
Power supply	NiCd batteries (28v., 12 amp-hr.)
Charging supply	19,152 solar cells
Power consumption	Standby: 10 w Active: 225 w
Launch vehicle	AF Thor-AbleStar
Contractors	Payload: Philco Corp. Antennas: Radiation, Inc. Ground equipment: ITT

Next Scout Shot Will Attempt Orbit

Propulsion, separation, guidance and control proved out successfully on the four stages of the all-solid *Scout* satellite launcher last week. The next shot, in about two months, will be orbital.

Telemetry on engine performance and an Air Force radiation experiment was received from the 112-lb. payload for 63 minutes of the 80-minute flight from Wallops Island, Va., to an altitude of more than 3500 statute miles and about 5800 miles down the Atlantic Missile Range.

Officials of the National Aeronautics and Space Administration said the launch Oct. 4 was the first known flight of a guided all-solid propellant vehicle with orbital capability. So far as is known, the Russians have never done anything comparable, said Elliot Mitchell, assistant director for propulsion in NASA's Office of Launch Vehicle Programs.

By programing the vehicle a little differently, it would have been possible to put the payload into orbit. However, Vincent L. Johnson, acting chief of *Scout* class vehicles, reported the technical staffs felt there was more assurance that the needed data would be obtained if the orbit attempt were deferred until *Scout*-3.

Three stages of *Scout*-1 fired when it was launched July 1. However, the third stage developed excessive roll and a sudden shift of the radar indicated that the vehicle was deviating from its programed course. As a result, ignition of the fourth stage was prevented by command from Wallops Island as a safety precaution. Subsequent examination of telemetry showed that the vehicle was still on course.

To prevent repetition of the excessive roll, the thrust of the roll-control jets was more than doubled in *Scout*-2. Johnson reported the new jets appeared adequate in the first scan of the telemetry.

Scout Data

Height	72 ft.
Weight on pad	36,600 lbs.
Payload	112 lbs.
Altitude reached	3500 mi.
Distance traveled	5800 mi.
Stages	1. Aerojet Algol, 115,000 lbs. thrust; 2. Thiokol Castor, 55,000 lbs. thrust; 3. Hercules Antares, 13,600 lbs. thrust; 4. Hercules Altair, 3100 lbs. thrust
Guidance	Minneapolis-Honeywell
Payload capability	150 lbs. in orbit

The *Scout* program will be transferred to Wernher von Braun's George C. Marshall Space Flight Center at Huntsville, Ala., in about a year, Johnson reported. Langley Research Center has handled the job during initial development, with the aid of five major contractors.

The *Scout* development program calls for firing four vehicles in the current fiscal year and four in FY '62. Some time before the vehicle becomes operational, launching and assembly will be turned over to a prime contractor — probably Chance Vought, which has provided launch tower, frame and motor transition sections.

Mitchell said NASA is cooperating closely with the Air Force *Blue Scout* program, a more varied and in some cases more sophisticated program. The first *Blue Scout*—a smaller four-stage vehicle without guidance or orbital capability—was launched from Cape Canaveral last month. NASA has ordered vehicles for the first nine *Blue Scouts*. Arrangements beyond that are uncertain.

Mitchell and Johnson declared the development of *Scout* will greatly reduce the cost and complexity of launching small satellites. It will have an orbital capability between *Juno II* and *Thor-Able*—between 100 and 200 lbs. However, the overall cost—vehicle plus launching costs—of a *Thor-Able* is three to four times the projected cost of a *Scout*.

In the immediate future, *Scout* will be launched from existing towers at Wallops Island and Cape Canaveral. Under consideration is a proposal to build a tower in the NASA area at Pt. Arguello, Calif., for launchings down the Pacific Missile Range.

Another great advantage of *Scout*, Mitchell declared, is the relatively low cost of launch facilities.

The 72-ft., 36,600-lb. launch vehicle lifted a payload of 112 lbs. of instruments—including the 78-lb. Air Force package—and 80 lbs. of performance-measuring instruments on the first and third stages.

The Air Force package, prepared by the Special Weapons Center of Air Research and Development Command, was designed to measure the intensities in both Van Allen radiation belts. Such a device is also capable of detecting nuclear explosions in the space near the earth, through the artificial Van Allen belts such explosions establish, as demonstrated by Project *Argus*.

Besides Chance Vought, the major contractors are: Aerojet-General, first stage; Thiokol, second stage; Hercules Powder Co., third and fourth stages; Minneapolis-Honeywell, guidance and controls.

Saturn Booster Redesign Could Make Up Lost Time

by Jay Holmes

HUNTSVILLE, ALA.—Project *Saturn*, America's best hope for boost power to better the Soviets soon in space, has entered a critical engineering phase.

Early success or a delay of several months hang in the balance as Wernher von Braun's rocket engineers redesign the prototype SAT booster thoroughly in preparation for a series of static tests beginning in mid-November.

Oswald H. Lange, boss of the *Saturn* program at the Marshall Space Flight Center of the National Aeronautics and Space Administration, says he hopes the November series will provide all the data needed to finish construction of the first flight *Saturn*.

The flight bird, partially assembled, lies in a cradle in a Fabrication Division building here. Four of the eight engines —the four that will not swivel—are attached to the structure. Assembly will be completed after the November static tests. Meanwhile, single Rocketdyne engines are being tested while being swiveled.

Modifications of the prototype SAT are being made on the test stand, where it was erected last spring in preparation for the first series of static tests. In addition, some changes are being made on the stand itself.

• **Series delayed**—Last June 15, at the dedication of an IBM 7090 computer here, Von Braun announced that a second series of tests would begin in six to eight weeks. A month later, at the NASA-Industry conference in Washington, Lange stayed with this schedule, saying tests were to begin in August.

But as the promised time approached, it became apparent from study of telemetry tapes from the first series that many more changes would be necessary.

"We could run a series of tests now if we wanted," a Marshall Center spokesman said. "But it wouldn't be worth the expense and time, since we now know other changes must be made."

The second series was first rescheduled for the end of September. Then more data turned up, more changes became indicated, and the start was pushed back to mid-November.

• **Mid-'61 still target**—Is this slippage? "There is no question that static testing is three months behind schedule," says a NASA headquarters spokesman. "However, the technical people believe that most or all of the time will be made up by the November tests."

From top to bottom, everyone maintains that the first test is to come in mid-1961, as previously scheduled. During a tour of the Fabrication Division, one official told M/R the flight would be next summer. A reporter for another trade magazine was told the test would be June or July, 1961. Lange was perhaps a little more cautious, however, in his statement at the Marshall Center's Sept. 27 industry briefing, saying merely, "The initial firing will come in 1961."

While the first *Saturn* hangs in the balance, the NASA center is going to industry for major components in later birds of the R&D program. Bids are being asked on 42 propellant tanks, 70 in. in diameter, for *Saturns* No. 6 through No. 10, which are to be flown in 1963 and 1964. Two spare tanks are included.

Huntsville is receiving bids Oct. 30 on a contract to tool up by Oct. 15, 1961, deliver the first tank by April 8, 1962, and the 42nd tank by May 6, 1963. Tanks for the first five *Saturns* are being built in-house. Under present scheduling, *Saturn* No. 6 will be the second of five flown in 1963. It will be the third of a series tested with live first and second stages and dummy third stage.

Major *Saturn* contracts to be let:

–A new second stage, designated S-11, which will be in the later, four-stage *Saturn C-2*, clustering four Rocketdyne J-2 liquid hydrogen-LOX engines of 200,000 lbs. thrust apiece—bidders' conference next spring, proposals to be evaluated later in the year.

–Production of the operational S-1 booster, beginning with *Saturn* No. 11, to be flown in 1964 or 1965—procurement to begin in Fiscal Year 1962.

Bell's Maser to Broaden Spectrum

NEW YORK—Bell Telephone Laboratories today demonstrated an operating optical maser aimed at future communications systems. Similar in many respects to the system announced some weeks ago by Hughes Aircraft, the optical maser opens up possibilities of a vastly extended communication spectrum far beyond that of conventional radio frequencies.

Preliminary experiments have been conducted by Bell scientists between laboratories located at Murray Hill, N.J., and Holmdel, N.J.—a distance of about 25 miles.

The optical maser produces an intense and extremely narrow beam of light. Within its narrow cone and frequency band, the beam is more than a million times brighter than the sun. With further developments, such a beam might be used for interplanetary and earth-space communications purposes as well as in a variety of scientific applications.

Bell scientists pointed out that the optical maser fills all four requirements for use in a communication system for electromagnetic transmission of information: energy transfer, directionality, modulation, and frequency selectivity.

• **Heart of ruby**—The heart of the BTL maser is a synthetic ruby rod, 1½ in. long and ⅓ in. in diameter. The two ends of the rod are polished until extremely flat and parallel, then covered with a reflecting layer of silver thin enough to be slightly transparent. This ruby rod is held in the center of a spiral neon photoflash lamp, and illuminated with an intense flash of ordinary white light. The synthetic ruby is infused with "impurities" of chromium to enhance its emission efficiency.

Under the stimulated emission, the ruby produces light sixty times more monochromatic (of a single frequency) than the ordinary fluorescent light from ruby.

Secondly, the light is "coherent," or of a single phase. This is the primary difference between ordinary light sources (which diffuse widely over distance) and the maser light emission. Such coherence is a primary requisite for application in long-distance communications.

Thirdly, the cone angle of the ruby light is only one-tenth of a degree. Within this cone, the intensity of the light is far higher than could be obtained by the ordinary fluorescent process.

In the recent experiments, red flashes from the ruby maser transmitter at Holmdel were clearly visible to the naked eye at Murray Hill, and illuminated a circle there of only 200 feet in diameter.

Other applications of the optical maser mentioned by Bell scientists with their eye on the future include the control of chemical reaction, and the possibility of using the pressure of such directed light to control the orbits of satellites.

Valves and controls

AiResearch *has produced more than one million high performance valves and controls for gases and liquids operating at temperatures from −420°F. to +2000°F. and pressures to 6000 psig.*

Reliability and compatibility of systems applications are insured when *all* components are of AiResearch design and manufacture—backed by more than 20 years of experience in valves and controls and the most complete testing and production facilities available.

Please direct your inquiries to Control Systems, AiResearch Phoenix Division.

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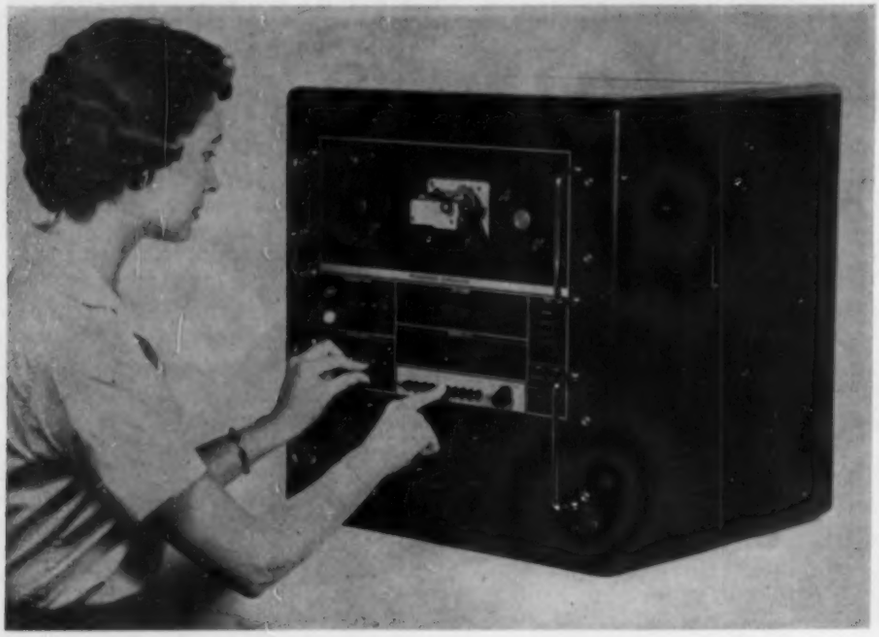


Automatic Electronic Systems Checker

A versatile, low-cost automatic checker for electronic systems has been developed by General Electric's Light Military Electronics Department.

GEPAC (General Electric Programmable Automatic Comparator), is intended to rapidly check the operational readiness of aircraft, missile and space electronic systems. The device can be used for factory test and quality control as well as on the Flight line.

By utilizing punched-tape test programs and appropriate adapters, GEPAC automatically checks eight basic electrical parameters of the equipment under test. Measured values are compared to allowable high and low limit values which have been programed on the tape. Test results are visually displayed in HI-LO-GO form or can be printed out.

If a test result is acceptable, GEPAC proceeds to the next test. Should a failure or malfunction be detected, a NO-GO indication is presented and testing is stopped. The operator may then turn to a subroutine on the tape and GEPAC will automatically proceed to isolate the module which is at fault.

Circle No. 225 on Subscriber Service Card.

Pure Cadmium Telluride

Semi-Elements, Inc. is manufacturing a semiconductor-grade cadmium telluride polycrystalline material that can be used as a basic material for growing single-crystal cadmium telluride. It is available in high-purity form and in doped concentrations P-type and N-type, with carrier concentrations ranging from 10^{16} to 10^{19} per cubic centimeter.

Circle No. 226 on Subscriber Service Card.

Motion Detector

A simple, reliable and extremely low cost device for detecting motion or the lack of motion has been developed by the Research Laboratories of Gaylord Products, Inc.

Although designed to "sense" increments of rotary motion as little as or less than ½ RPM, the device can also be utilized to detect linear motion by a simple conversion to rotary motion.

In addition, the motion detector can be manufactured for a great range of low-speed sensing requirements, when the detection of slow-downs or speed-ups is required.

Circle No. 227 on Subscriber Service Card.

Multipurpose Test Chamber

High Vacuum Equipment Corp. subsidiary of Robinson Technical Products, Inc., has introduced a product line of multipurpose self-contained environmental test chambers. With the addition of optional equipment, the chambers can be adapted to "dry box" welding. Cooling and heating equipment accessories are available to further expand the scope of the units. The chambers are designed and engineered to specification and can be adapted to fit a multitude of jobs, one of which is Electron Beam Welding. The chamber sizes lend themselves to the installation of the H.V.E. Corp. orbiting electron beam gun for doing closed loop welding or butt welding long tube sections which, because of configuration, cannot readily be moved but are held stationary while the electron beam gun is rotated.

Circle No. 228 on Subscriber Service Card.

Shock Proof Recorder

A miniature missile-borne magnetic tape recorder, designed to record through a 500-g impact deceleration and survive a 1500-g shock without loss of recorded data, is being developed by the Westrex Corp., a division of Litton Industries.

Fourteen tracks on one-inch tape are utilized to record data from accelerometers and other types of transducers. Recording can be accomplished with an inline Westrex 14-track magnetic head or a staggered array of two 7-track heads, depending on cross-talk requirements.

Circle No. 229 on Subscriber Service Card.

High Dielectric Film

A film-forming and moldable dielectric (Cyanocel) having the highest dielectric constant (12.5) of all known organic film-forming materials has been developed by American Cyanamid Co.

Clear, transparent films as thin as 0.1 mil or as thick as 5 mils or more have been cast from solutions of Cyanamid's highly cyanoethylated cellulose in a number of organic solvents or solvent mixtures. At a frequency of 60 cycles, the 2-mil films have a dielectric

constant of 10-15 and a dissipation factor of 0.010-0.025.

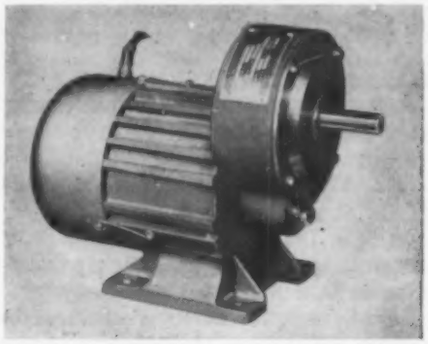
In addition to their unusual electric properties, films of Cyanocel have good flexibility and physical strength. At 23°C and 50% relative humidity, 2-mil films have a tensile strength of 5380 psi and a Young's modulus of 0.34 x 10^6 psi.

Circle No. 230 on Subscriber Service Card.

Induction Motor for GSE

Kearfott Division of General Precision, Inc. is marketing a DEF-15-1 Induction Motor to its extensive line of miniature and subminiature special service motors for both military and industrial uses.

Thermally protected and explosion proof, this continuous duty motor is



totally enclosed, fan cooled, base mounted, and ruggedly constructed. The DEF-15-1 unit qualifies according to the humidity, salt spray, sand, dust, shock, and vibration specifications of MIL-E-5272A, and it also conforms to the applicable portions of MIL-M-7969A.

Circle No. 231 on Subscriber Service Card.

Fast Response Valve

Designed for use with hydraulic fluids, inert gases, hydrogen peroxide, Viton "A," Buna "N," or nylon seats—depending on the line fluid—provide fast response and positive sealing in a check valve manufactured by Marotta Valve Corp. The standard CVM4C model has an operating pressure of 3000 psig, with a high-pressure version to 4500 psig. All models operate at temperatures from −65°F to +160°F. Male ports per AND 10056-4 are for connection with ¼ in. tubing or hose. Overall length is 2.280 in., diameter of 0.812 in. and weight 1.2 oz.

Circle No. 232 on Subscriber Service Card.

Mechanical Vacuum Gage

Consolidated Vacuum Corp. has a completely mechanical diaphragm gage for use in measuring total pressures of all gases from atmosphere to 0.2 mm Hg.

The inexpensive gauge, known as the GHD-100, was designed for in-

stallation directly to a vacuum system and requires no electrical connections. Its principle of operation is the deflection of a thin metal diaphragm by a change in pressure. The diaphragm is made of corrugated copper-beryllium.

Circle No. 233 on Subscriber Service Card.

Numerical Control System

The Singer numerical control system, offering a simple, straight-forward approach to numerical control, is available from Diehl Manufacturing Co., a subsidiary of The Singer Manufacturing Co.

The Singer system provides up to ±0.0002 on a 40 in. work table, and flexibility and economy of operation through modular design. Modular components include a tape reader, distributor, digital analog converter, notch phase discriminator, amplifier, DC power supply, motor gear drive, position indicator control and servo-micrometer. Rapid change of these units is easily accomplished by a plant technician.

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Ball Bearing Analyzer

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universally accepted

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The master instrument to set up and check angles to .1 second over 10 minutes of arc. With simple accessories it establishes squareness, parallelism, flatness, angles, and circular spacing under normal shop conditions independent of distance and temperature. Used as standard for testing of surface plates and machine tool alignment, control of ultra-precision gear cutting devices, test fixtures and tables for missile guidance units.

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and roller bearing quality has been introduced by Bearing Inspection, Inc.

Model BA-20-2 bases its analysis upon the vibrations produced by a rotating bearing, and it indicates unserviceable bearings, both visually and audibly, by means of a meter, C.R.T. display and a loudspeaker. Normal operation allows a complete non-destructive check of bearing surface conditions and cleanliness in an average time of less than 30 seconds.

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new literature

SPAGE AGE PACKAGING—Cushioning materials and reusable shipping containers used in the protective packaging of fragile Space Age products are fully described in an illustrated brochure from Nash-Hammond Inc. Shipping containers are discussed in detail, including materials, types and applications. Container materials range from steel to fiberglass and a wide variety of cushioning materials and shock-absorbing systems are employed to provide absolute protection.

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INFRARED SOURCE CALIBRATION—A technical data sheet describing the Model PE-537 Infrared Source Calibration System, which provides a versatile means for checking, maintaining and adjusting infrared reference sources to a known IR radiation power level, has been published by the Electro-Optical Division of the Perkin-Elmer Corp. The secondary calibration system permits a simultaneous comparison of infrared sources with a secondary standard reference source whose radiation characteristics are accurately known.

Circle No. 201 on Subscriber Service Card.

ULTRA PURE GOLD—Technical Bulletin HP-101 describing 99.999% pure gold for semiconductor and other applications is now available from High Purity Metals, Inc. The bulletin describes the use of ultra-pure gold in semiconductor applications as a matrix element for forming low temperature solders for joining silicon, and as a carrier for doping elements.

Circle No. 202 on Subscriber Service Card.

DYNAMIC DIGITAL LOGIC CONFERENCE—A 72 page booklet recording the Proceedings of the First Users' Conference on Dynamic Digital Logic held March 1960 at Beverly Hills, Calif. is available from Computer Control Co. Inc. Topics of the papers include Application of Digital Techniques in a Meteor Burst Communication System, Generation of Periodic Pulse Patterns, a Method of Running Off a Quotient to the Nearest Integer, Logical Design Simulation Techniques using the IBM 709 Computer, Serial Techniques in Digital Systems and Serial Techniques in the Design of an Incremental Computer.

Circle No. 203 on Subscriber Service Card.

PROGRESS IN POWER FOR SPACE—An 8-page bulletin describing electrical power systems for missiles, satellites and space vehicles being flight tested and researched by the General Electric Co. Designated PIB-A-9, the publication includes analyses, applications and power potentialities of solar termionic, photovoltaic cell, fuel cell, storage battery, nuclear reactor, thermoelectric and magnetohydrodynamic power systems.

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POWER TRANSISTOR HANDBOOK—Following up on the Zener Diode Handbook, Motorola Applications Engineers completed a 200 page handbook devoted entirely to power transistor theory, design, and applications. The new handbook is intended to serve as an accurate guide in the use of the versatile power transistor. Supplemented by more than 200 drawings and charts, plus numerous design problems and solutions, the book serves as a reference as well as an introduction to power transistor applications.

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AND THREAD

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names in the news

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DIETRICH

SCHMIDT

LEWIS

ROSEN

Herbert H. Rosen: Selected as corporate director of public relations for Hoffman Electronics Corp., responsible for expanding activities in five divisions; Consumer Products, Industrial Products, Military Products, Science Center and Semiconductor. Was formerly assistant director for Educational Programs for the National Aeronautics and Space Administration.

John E. Clarke: Joins Computer Diode Corp. as manager of applications engineering. Was formerly manager of applications engineering at Silicon Transistor Corp. and chief of applications engineering of the Semiconductor Div. of General Instrument Corp.

Robert C. Murrell: Appointed director, Quality Control at Melpar, Inc. Formerly quality control manager-engineering division, he now has responsibility for both the engineering and production divisions.

Jerome Berger: Former vice president and general manager of the Brach Manufacturing Div. of General Bronze Corp., named sales manager of the Contract and Special Products Div. of JFD Electronics Corp.

Richard Lewis, Jr.: Appointed advertising manager for Spectrol Electronics Corp., directing all advertising and sales promotion activities. He will report to **D. P. Vaughan,** marketing manager. Prior to joining the firm, was public relations and sales promotion manager for Fairchild Semiconductor Corp.

Capt. Frank W. Taylor (USN-ret.): Joins Consolidated Systems Corp. as assistant to the engineering vice president. For the past three years, he was head of the Auxiliary Ships Branch, Bureau of Ships.

W. W. Smith: Named chief of engineering development at Babcock Electronics Corp. He will head the firm's engineering development program in the field of remote guidance and control.

Robert V. Schmidt: Former vice president of United Research Inc., joins Northrop Corp.'s Norair Division as chief of research marketing.

Laurence R. Alexander: Appointed technical liaison manager of Patterson Moos Research Div., Leesons Corp. Has been a senior engineer on the firm's professional staff for the past seven years.

Robert L. Schwerin: Named quality control manager of ACF Industries Electronics Div. at Paramus, N.J. Was formerly manager of reliability and quality assurance in the government electronics division of Emerson Radio and Phonograph Corp.

Rear Adm. Neil K. Dietrich (USN-ret.): Elected a vice president of Hazeltine Corp. Prior to joining the firm he was director of Economic Research of the Charleston (S.C.) Development Board.

Frederick E. Carroll: Former project engineer promoted to the new post of Operations manager, Data Storage Operations, in the Computer Products Div. of Laboratory for Electronics, Inc.

Robert S. Meadows: Joins the electronics and avionics division of the Emerson Electric Manufacturing Co. as product manager of the firm's Electronic Systems Laboratory.

Ansel J. Gere, Deane A. Beytes, Andre M. Castellano: Named antenna engineer, project engineer and quality control manager, respectively, at Antenna Systems, Inc.

Dr. Egon A. DeZubay: Former manager of preliminary product evaluation in the research division of Curtiss-Wright Corp., joins Atlantic Research Corp. as a fuels and combustion specialist in the firm's nuclear engineering projects.

Roger W. Tuthill: Formerly assistant manager of the equipment engineering and development department for Air Reduction Sales Co., named manager-engineering in the firm's Special Products Dept.

Angus G. MacLean: Appointed senior applications analyst, specializing in the fields of high mathematics, statistics and space technology for the Computer Div. of Clary Corp.

Robert B. Abbey: Appointed senior product engineer at the Rialto rocket motor plant of B. F. Goodrich Aviation Products. Was formerly associated with Rocket Power/Talco.

Roy H. Olson: Former general manager of Motorola, Inc.'s Chicago Military Products Center joins Hughes Aircraft Co.'s communications division as director of engineering laboratories.

P. P. Hoppe and **C. D. Stephenson:** Appointed general engineering manager and product engineering manager, respectively of the Amphenol Connector Division of Amphenol-Borg Electronics Corp.

Bernhard Yagerman: Joins Telechrome Manufacturing Corp. as sales manager, Electronics Division. Was formerly with Underwood's Canoga Division.

Dr. Norman Lee Barr: Elected head of biological sciences and systems department for General Motors Defense Systems Division. Dr. Barr's group will study natural and artificial environmental phenomena as related both to man's ground and space activities. He formerly served on the committee that established environmental control criteria for Project *Mercury,* selected the astronauts and developed their training program.

Karl R. Wendt: Elected executive vice president of Colorado Research Corp. He will continue as manager of the Research Dept. where he has been in charge of the company's digital television development program.

Michael Hacskaylo: A solid state physicist, formerly with the National Aeronautics and Space Administration, joins Semi-Elements, Inc., as director of research.

Harry A. Lucas, Jr.: Former sales manager of Minneapolis-Honeywell's Systems Div. joins CompuDyne Corp. as corporate sales consultant.

Joseph P. Gordon: Former general manager of Allen P. Dummont Laboratories' Electronic Tube Division, elected vice president of the Cathode Ray Tube Division of Electronic Tube Corp.

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M/R Readers Speak

(Continued from page 14)

strategic, tactical and defensive forces.

If we try too hard to do this, we may introduce an inflexibility of mind and maneuver which will react against us much as the Maginot Line did against the French. It is also sometimes difficult to know the meaning of the terms strategic and tactical. Our armed forces should have the utmost in flexibility, mobility and hitting power. If they have these things, they can be adapted to situations as they develop irrespective of what name you give them.

I would also caution against further centralization of the command of the armed forces. This country grew great because of individual initiative, by decentralization and by delegation of authority. Let us not defeat ourselves by monolithic organization of the armed forces which render progress and decision making even more difficult.

The main military needs in space are reconnaissance, communications, meteorological information and navigation. Fighting in outer space seems, at present, somewhat visionary. I can foresee that an enemy might want to deny our use of space for the above purposes. But I cannot subscribe to the view that future wars will be limited wars—limited to fighting in space. As long as men fight, they will fight on the land and on the sea with the best weapons they can get. We must not forget that territory must be held and that men must eat. For this we need ground forces and naval forces to control the seas.

There are some basic concepts appropriate to space which must be studied. If the air space above a nation's territory is under the jurisdiction of that nation, how high up does this jurisdiction extend? Should we seek to establish a principle of the Freedom of Space much the same as we have upheld our traditional doctrine of the Freedom of the Seas?

Your letter and proposals are stimulating and you are to be commended for bringing these vital issues to the fore.

Harry Sanders
Vice Admiral, USN (Ret.)
Dallas

Offer of Help

To the Editor:

AGREE WHOLEHEARTEDLY WITH LETTER TO NIXON AND KENNEDY. WHAT CAN I DO TO HELP?

LOU GALASSI
PROVIDENCE, R.I.

Wider Circulation Urged

To the Editor:

Congratulations on "An open letter to Richard Nixon and John Kennedy," also on your 9 point proposal. In my opinion, it would be a good idea if "An open letter . . ." and the replies could receive much wider circulation than they will get in M/R. It might help to wake the country up. Also while I am on the subject of wider circulation, it seems to me that it would be a good idea to have your editorials by Mr. Clarke Newlon published separately in book or booklet form. They could be distributed much more widely this way. This could do much to counteract the "Oh well, we're ahead of the Russians, we have color TV and they haven't" attitude in the country today.

David W. Johnston
Washington, D.C.

Wholehearted Agreement

To the Editor:

I hasten to express enthusiastic and wholehearted agreement with your open letter to Vice President Nixon and Senator Kennedy and the nine-point proposal you have set forth. I also wish to congratulate you on this public service.

R. H. Isaacs
Vice President-Military Relations
The Bendix Corp.
Detroit

Reviews

MECHANICAL PROPERTIES OF SELECTED ALLOYS AT ELEVATED TEMPERATURES, H. A. Pearl and others. Order PB 161761 from Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C. 268 pp., $4.

Of six commercially available alloys designed for high temperature applications, Air Force-sponsored tests showed A 286 steel to have the greatest stability of properties over the maximum temperatures and time ranges of exposure used in this study.

Tests were designed to determine changes resulting from temperature alone and changes resulting from structural alterations in the materials.

A PRACTICAL INTERPRETATION OF DIELECTRIC MEASUREMENTS UP TO 100-MC., J. J. Chapman and L. J. Frisco, The Johns Hopkins University, for U.S. Army. Order PB 161545 from Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C. 207 pp., $3.50.

This handbook summarizes the data and discusses results of an investigation of the behavior of solid insulating materials over the frequency range of 60-cps to 100 mc.

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editorial . . .

Kennedy's Stand on Defense and Space

THE OPEN LETTER which the editors of MISSILES AND ROCKETS addressed to the two Presidential candidates has served to break the barrier of silence both had maintained on the defense and space issue.

Senator John Kennedy was the first to reply and we are glad to carry his letter (pages 12 and 13) as sent to us under his byline on October 3. Vice President Nixon has indicated that his answer to M/R's open letter (carried last week) will be forthcoming shortly—probably in time for the October 17 issue.

In answering M/R's appeal that the defense and space issue be brought into the open, Senator Kennedy did well in making his stand clear. His detailed comments on each of the nine points in M/R's proposal were forthright and contained little equivocation.

The first point made by M/R was that the United States recognize that we are in a strategic space race with Russia. Senator Kennedy said:

"We are in a strategic space race with Russia and we have been losing . . . Control of space will be decided in the next decade. If the Soviets control space they can control earth, as in the past centuries the nation that controlled the seas dominated the continents."

He declined to be pinned down to dates for suggested space exploration accomplishments, but said: "All these things and more we should accomplish as swiftly as possible. This is the new age of exploration; space is our great New Frontier."

Commenting on "freedom of space" he did not specifically mention the role of the military, but said: "The United States must have a pre-eminence in security as an umbrella under which we can explore and develop space for the benefit of mankind."

He proposed a reorganization of the Department of Defense according to functions and missions. While he did not mention unified services or a single service, he proposed studying the feasibility of a Defense Department organization with five commands—Strategic, Tactical, Continental Defense, Material and Development.

Senator Kennedy proposed specific action in January of 1961 as suggested by M/R editors for modernity and mobility in the armed forces. He agreed on acceleration of *Polaris* and *Minuteman* programs, expanding conventional forces and construction of missile bases. He did not comment on the B-70 program. On budget ceilings he said:

"Defense spending must be based on the security needs of the nation not the pre-determined confines of a budget . . . Research cannot be started and stopped according to the whims of the budgeteer."

IN RESPONSE TO M/R's proposal to streamline defense regulations and procedures to make industry's defense and space role more effective, he said:

"Certainly defense regulations and procedures must be simplified, and the proliferation of secretaries, assistant secretaries, under-secretaries, special assistants and deputy assistants to secretaries, boards, commissions, councils and committees must be rolled back."

He said that national scientific goals "will be our first objective." On decision-making in the defense and space program, he wrote:

"The Democratic Party has strength in depth among dedicated men familiar with defense problems. They will have a mandate to speed the decision-making process, and authority to make affirmative decisions very quickly."

MISSILES AND ROCKETS takes pride in the fact that it has been in some degree instrumental in bringing the defense and space issue out into the open. We hope to carry Vice President Nixon's reply to our open letter in equal detail.

We have suggested that this issue be brought out further—specifically in the televised debates between the candidates. We feel that the facts are neither widely nor fully understood by the U.S. public. We feel it is vital to survival that they be understood.

Clarke Newlon

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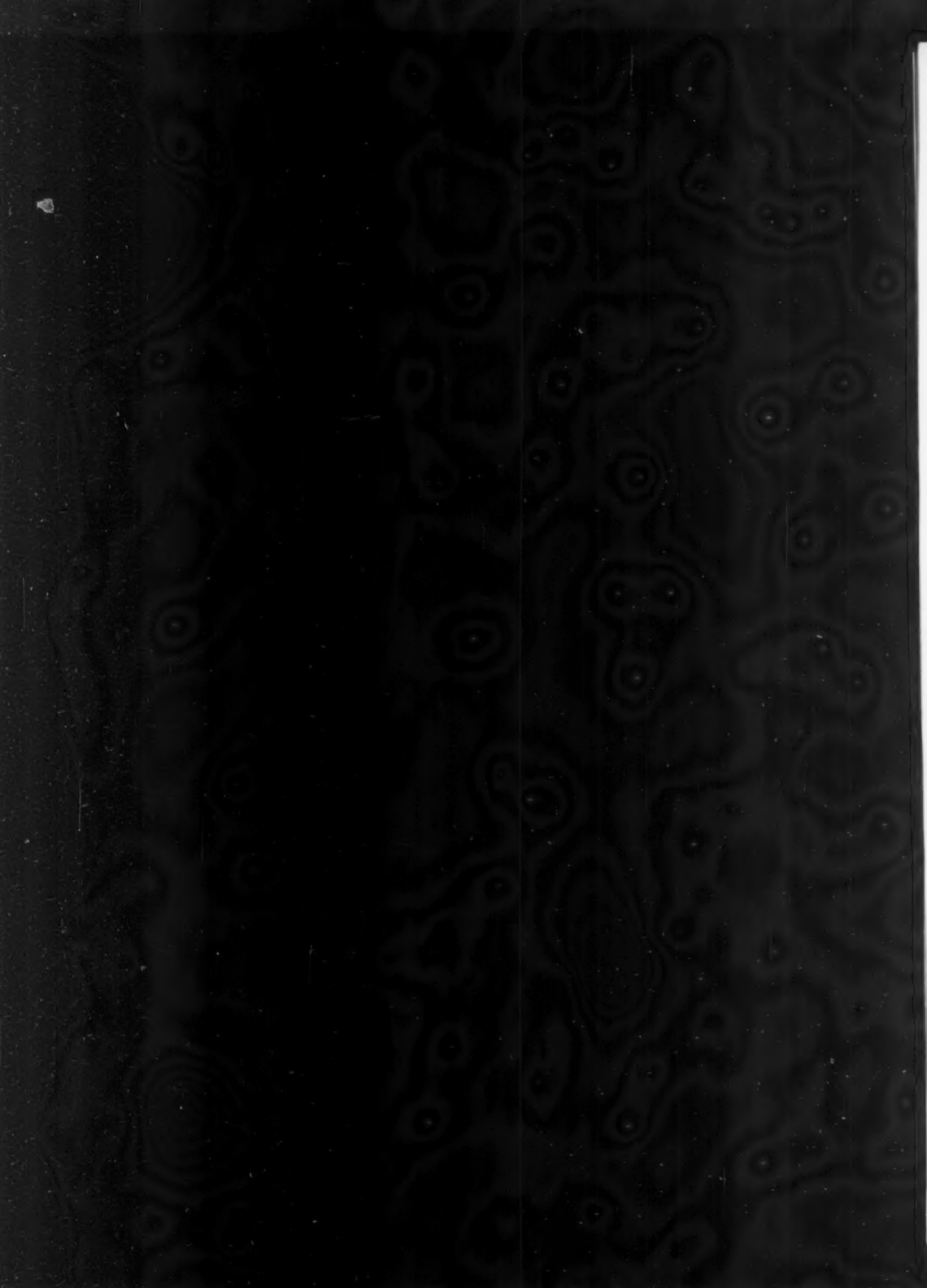

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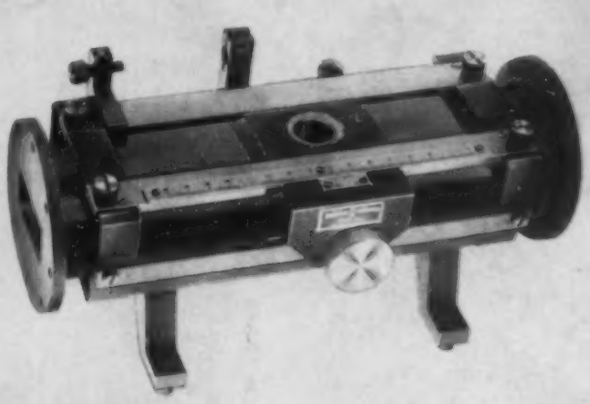

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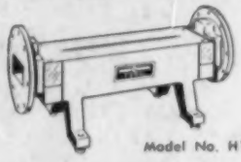
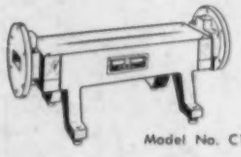
- no slope adjustment required
- vernier position scale readable to 0.1 mm.
- dial gauge holder and movable stop
- tapered slots to minimize residual VSWR

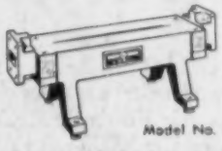
INTERCHANGEABLE WAVEGUIDE SECTIONS



Model No. H115A



Model No. C115A



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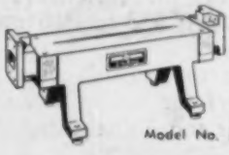

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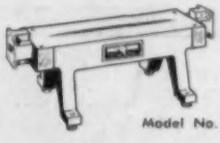
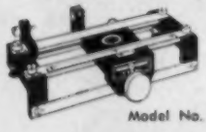


Model No. Y115A

UNIVERSAL CARRIAGE



Model No. Z116A

Like the finest camera with a precisely fitted set of lenses, the FXR Universal Carriage and family of five Interchangeable Slotted Sections are matched to perfection. "Togetherness" with this unrivalled modular waveguide system gains new meaning . . . more rapid interchange of each section without tools or need for alignment, and more dependable performance over the entire frequency range from 3.95 kmc to 18.00 kmc. Another fine FXR "package" with quality and reliability built into it—from the first mark on the drawing board.

SERIES 115 PRECISION SLOTTED SECTIONS

MODEL NO.	FREQUENCY RANGE (KMC)	WAVEGUIDE DIMENSIONS (Inches)	INSERTION LENGTH	WAVEGUIDE TYPE	FLANGE TYPE
H115A	3.95- 5.85	2 x 1	10⅜ in.	RG-49/U	UG-149A/U
C115A	5.85- 8.20	1½ x ¾	10⅜ in.	RG-50/U	UG-344/U
W115A	7.05-10.00	1¼ x ⅝	10⅜ in.	RG-51/U	UG-51/U
X115A	8.20-12.40	1 x ½	10⅜ in.	RG-52/U	UG-39/U
Y115A	12.40-18.00	0.622 x 0.311 ID	10⅜ in.	RG-91/U	UG-419/U

ACCESSORY: FXR Model No. B200A Tunable Probe.
All units when mounted in Z116A Carriage:
Slope—1.01 max. Irregularity—1.005 max.

Write for Bulletin No. SS115 or contact your local FXR representative.

FXR, Inc.

Design • Development • Manufacture

25-26 50th STREET • RA. 1-9000
WOODSIDE 77, N. Y. • TWX: NY 43745

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